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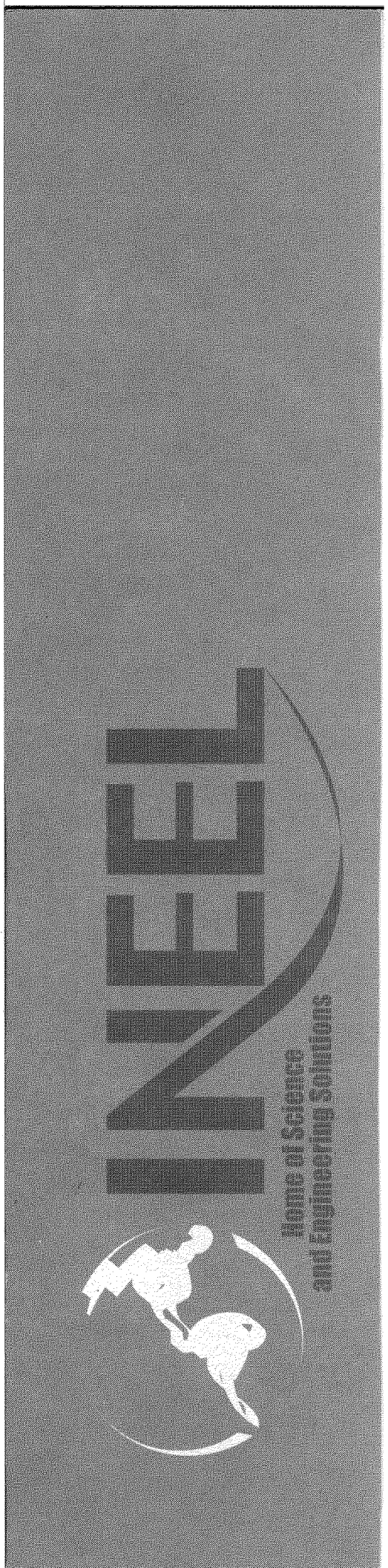
Revision 0

Health and Safety Plan for INEEL CERCLA Disposal Facility Operations

February 2003



Idaho National Engineering and Environmental Laboratory
Bechtel BWXT Idaho, LLC

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Health and Safety Plan for INEEL CERCLA Disposal Facility Operations

February 2003

Idaho National Engineering and Environmental Laboratory
Environmental Restoration Program
Idaho Falls, Idaho 83415

Prepared for the
U.S. Department of Energy
Assistant Secretary for Environmental Management
Under DOE Idaho Operations Office
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ABSTRACT

This Health and Safety Plan establishes the procedures and requirements used to eliminate and/or minimize health and safety risks to persons performing operational tasks at the INEEL CERCLA Disposal Facility (ICDF) at the Idaho Nuclear Technology and Engineering Center, located at the Idaho National Engineering and Environmental Laboratory. This document has been prepared to meet Occupational Safety and Health Administration standard, 29 Code of Federal Regulations 1910.120, "Hazardous Waste Operations and Emergency Response Requirements."

The operational safety basis for the ICDF is further evaluated in the "ICDF Complex Hazard Classification" (HAD-136, in process). The unreviewed safety questions process, in accordance with applicable company policies and procedures, will evaluate additional operations.

This Health and Safety Plan contains the safety, health, radiological hazards assessment, and associated mitigation for conducting general operational tasks at the ICDF. Safety, health, and radiological professionals assigned to support ICDF operations will define the most appropriate hazard control and mitigation measures based on facility-specific conditions and shall make changes to this document and associated work control documents, as appropriate.

CONTENTS

FIGURES

TABLES

ACRONYMS

ACGIH	American Conference of Governmental Industrial Hygienists
ALARA	as low as reasonably achievable
ANSI	American National Standards Institute
anti-C	anticontamination
AOC	area of contamination
APF	assigned protection factor
APR	air-purifying respirator
ASA	auditable safety analysis
BBWI	Bechtel BWXT Idaho, LLC
CAM	continuous air monitor
CAMU	Corrective Action Management Unit
CERCLA	Comprehensive Environmental, Response, Compensation and Liability Act
CFA	Central Facilities Area
CFL	central file location
CFR	*Code of Federal Regulations*
CPP	Chemical Processing Plant (now the INTEC)
DAC	derived air concentration
dBA	decibel A-weighted
DOE	Department of Energy
DOE-ID	Department of Energy Idaho Operations Office
EAM	emergency action manager
ECC	Emergency Control Center
EDF	Engineering Design File
EPA	Environmental Protection Agency
ER	environmental restoration

ERIS	Environmental Restoration Information System
ERO	Emergency Response Organization
ES&H	environment, safety, and health
ESH&QA	environment, safety, health, and quality assurance
FFA/CO	Federal Facility Agreement and Consent Order
FR	*Federal Register*
FTL	field team leader
GFCI	ground-fault circuit interrupter
GI	gastrointestinal
GM	Geiger-Mueller
H&R	hoisting and rigging
HASP	Health and Safety Plan
HASS	Hazards Assessment and Sampling System
HAZWOPER	Hazardous Waste Operations and Emergency Response
HEPA	high-efficiency particulate air
HSO	health and safety officer
HVAC	heating, ventilating, and air conditioning
HWMA	Hazardous Waste Management Act
ICDF	INEEL CERCLA Disposal Facility
ICMS	INEEL Chemical Management System
IDLH	immediately dangerous to life or health
IDW	investigation-derived waste
IH	industrial hygiene, industrial hygienist
INEEL	Idaho National Engineering and Environmental Laboratory
INTEC	Idaho Nuclear Technology and Engineering Center
IRT	Incident Response Team

ISMS	Integrated Safety Management System
ISRMS	INTEC Services Record Management Supervisor
ITP	individual training plan
JSA	job safety analysis
LDR	land disposal restriction
LEL	lower explosive limit
LO/TO	lockout/tagout
MCP	management control procedure
MPS	Material Profile Sheet
MSDS	material safety data sheet
NEPA	National Environmental Policy Act
NFPA	National Fire Protection Association
NIOSH	National Institute of Occupational Safety and Health
NRR	noise reduction rating
OMP	Occupational Medical Program
OSC	on-scene commander
OSHA	Occupational Safety and Health Administration
OU	operable unit
PCB	polychlorinated biphenyl
PCM	personal contamination monitor
PEL	permissible exposure limit
PM	project manager
PNOC	particles not otherwise classified
PPE	personal protective equipment
PRD	program requirements document
QA	quality assurance

QAPjP	Quality Assurance Project Plan
QC	quality control
QE	quality engineer
RadCon	Radiological Control
RAWP	Remedial Action Work Plan
RBA	Radiological Buffer Area
RCA	Radiologically Controlled Area
RCIMS	Radiological Control and Information Management System
RCRA	Resource Conservation and Recovery Act
RCT	radiological control technician
RD/RA	remedial design/remedial action
RE	radiological engineer
RMD	Records Management Department
ROD	Record of Decision
RW	radiological worker
RWP	radiological work permit
SAD	site area director
SAM	Sample and Analysis Management
SAR	Safety Analysis Report
SCBA	self-contained breathing apparatus
SOM	shift operational meeting
SP	safety professional
SRPA	Snake River Plain Aquifer
SSA	Staging and Storage Annex
SSSTF	Staging, Storage, Sizing, and Treatment Facility
STL	shift technical lead

SWB	standard waste box
SWP	safe work permit
TLV	threshold limit value
TPR	technical procedure
TSCA	Toxic Substances Control Act
TSD	treatment, storage, and disposal
TSDF	Treatment, Storage, and Disposal Facility
TSR	technical safety requirement
TWA	time-weighted average
USCG	United States Coast Guard
UV	ultraviolet light
VOC	volatile organic compound
VPP	Voluntary Protection Program
WAC	Waste Acceptance Criteria
WAG	waste area group
WBGT	wet bulb globe temperature
WCC	Warning Communications Center

Health and Safety Plan for INEEL CERCLA Disposal Facility Operations

1. INTRODUCTION

This Health and Safety Plan (HASP) identifies health and safety hazards and requirements used to eliminate and/or minimize the hazards during INEEL CERCLA Disposal Facility (ICDF) operations at the Idaho Nuclear Technology and Engineering Center (INTEC), located at the Idaho National Engineering and Environmental Laboratory (INEEL). This HASP has been written to meet the requirements of the Occupational Safety and Health Administration (OSHA) standard, 29 CFR 1910.120, "Hazardous Waste Operations and Emergency Response" (HAZWOPER). Additional operations will be evaluated by the unreviewed safety questions process, in accordance with applicable company policies and procedures.

1.1 Purpose

This plan has been prepared to address ICDF operational hazards and associated mitigation based on general operations as a Treatment, Storage, and Disposal Facility (TSDF). This HASP and additional job safety analyses (JSAs), operational technical procedures (TPRs), and management control procedures (MCPs) will further define ICDF operational hazards, mitigation, and procedural requirements as the facility begins operations and new hazards are identified. These documents will be maintained at the ICDF Complex as an operational requirement; many of these documents were not submitted for Agency review as part of the Remedial Action Work Plan (RAWP). This HASP will be reviewed and revised, as appropriate, by ICDF industrial hygiene (IH), industrial safety, and radiological operations personnel to ensure its effectiveness and suitability for ICDF operations.

ICDF operations will be conducted under the administrative controls of an auditable safety analysis (ASA). TPRs, JSAs, and other appropriate process health and safety evaluations will be conducted to ensure operations are conducted in compliance with the facility authorization basis. ICDF operations will fall within the site area director's (SAD's) jurisdiction. This HASP applies to all personnel conducting ICDF operational activities.

1.2 INEEL Site Description

The INEEL is a U.S. government-owned test site, managed by the Department of Energy (DOE), that is located in southeastern Idaho, 51.5 km (32 mi) west of Idaho Falls (Figure 1-1). The INEEL encompasses approximately 2,305 m^2 (890 mi^2) of the northeastern portion of the Eastern Snake River Plain. The Eastern Snake River Plain is a relatively flat, semiarid, sagebrush desert, with predominant relief being manifested either as volcanic buttes jutting up from the desert floor or as unevenly surfaced basalt flows or flow vents and fissures. Elevations on the INEEL range from 2,003 m (6,572 ft) in the southeast to 1,448 m (4,750 ft) in the central lowlands, with an average elevation of 1,516 m (4,975 ft). Drainage within and around the plain recharges the Snake River Plain Aquifer (SRPA), a sole-source aquifer that flows beneath the INEEL and surrounding area. The aquifer is approximately 137 m (450 ft) below ground surface within the site boundaries. Regional groundwater flow is southwest at average estimated velocities of 1.5 m/day (5 ft/day).

The U.S. Atomic Energy Commission initially established the site in 1949 as the National Reactor Testing Station for nuclear energy research and related activities. In 1952, the Site expanded its function and began accepting shipments of transuranic radionuclides and radioactive low-level waste. In 1974, it was redesignated the Idaho National Engineering Laboratory, and then, in 1997, in order to reflect the

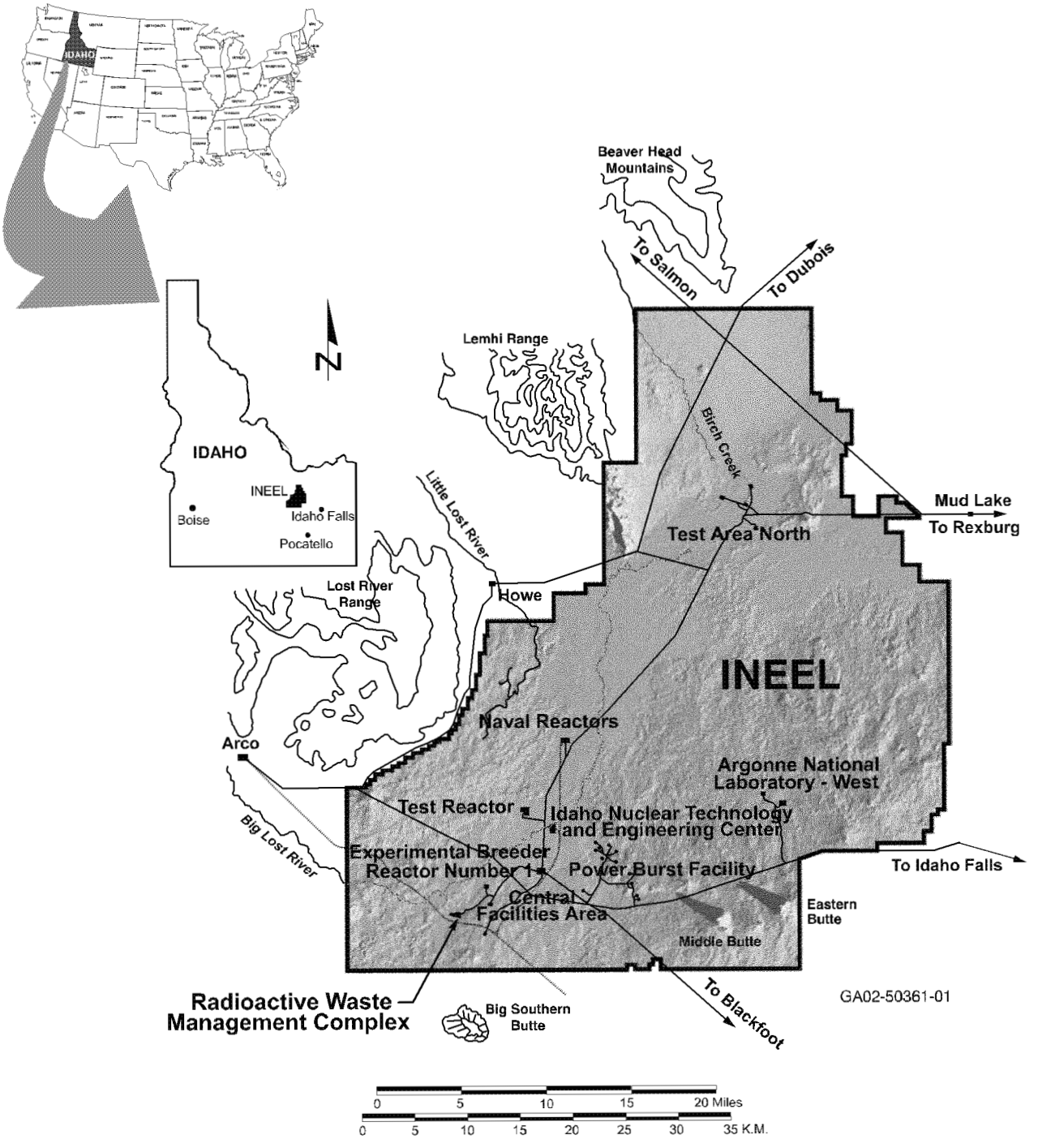

Figure 1-1. Map of the Idaho National Engineering and Environmental Laboratory.

expansion of its mission to include a broader range of engineering and environmental management activities, the name was changed to INEEL. Currently, the INEEL is used to support the engineering efforts and operations of the DOE and other federal agencies in areas of nuclear safety research, reactor development, reactor operations and training, nuclear defense materials production, waste management technology development, and energy technology and conservation programs. The DOE Idaho Operations Office (DOE-ID) has responsibility for the INEEL and delegates authority to operate the INEEL to government contractors. Bechtel BWXT Idaho, LLC (BBWI) provides management and operating services to the majority of INEEL facilities for DOE-ID.

In November 1989, because of confirmed contaminant releases to the environment, the Environmental Protection Agency (EPA) placed the INEEL on the National Priorities List of the National Oil and Hazardous Substances Pollution Contingency Plan (54 FR 48184). In response to this listing, the DOE, the EPA, and the State of Idaho negotiated the *Federal Facility Agreement and Consent Order* (FFA/CO) *and Action Plan for the Idaho National Engineering Laboratory* (DOE-ID 1991). The FFA/CO and Action Plan, which was signed in 1991, established the procedural framework and schedule for developing, prioritizing, implementing, and monitoring response actions at the INEEL in accordance with the Comprehensive Environmental Response, Compensation and Liability Act (CERCLA) (42 USC 6901 et seq.), the Resource Conservation Recovery Act (RCRA) (42 USC 6921 et seq.), and the Idaho Hazardous Waste Management Act (HWMA) (HWMA 1983).

1.3 INTEC Site Description

The INTEC, located in the south-central portion of the INEEL, commenced operations in 1952. Historically, the INTEC has been a uranium reprocessing facility for both defense projects and research, while also acting as a storage facility for spent nuclear fuel. Irradiated defense nuclear fuels were reprocessed to recover unused uranium. Liquid waste generated from these activities was either stored at the INTEC tank farm for treatment at the calcining facility or disposed of in the INTEC injection well, CPP-23. After fuel dissolution and extraction, the liquid waste was calcined, and the resultant granular solids were subsequently stored in stainless steel bins. Depending on the type of fuel reprocessing used, several types of high-level radioactive liquid waste have been produced at the INTEC. A phase-out of the INTEC's reprocessing activities began in 1992, including fuel dissolution, solvent extraction, product denitration, and other processes.

The geology at INTEC consists of a layered sequence of fractured basalt flows with intercalated sediments, commonly referred to as sedimentary interbeds. The depth to the SRPA is approximately 138 m (455 ft). Several sedimentary interbeds are present in the basalt above the water table. Two major perched water zones are associated with interbeds at depths of approximately 115 m (380 ft) (deep perched water) and between 33 to 42 m (110 to 140 ft) (shallow perched water). The shallow perched zone (33 to 42 m [110 to 140 ft]) actually consists of two separate perched zones in the vicinity of the tank farm, which lie on the CD interbed and the DE 1-2 interbed, respectively. These are referred to as the upper shallow and lower shallow perched water zones. Perched water at a depth of approximately 115 m (380 ft) is referred to as the deep perched water. Below the water table is the HI interbed, present at a depth of approximately 158 to 164 m (520 to 575 ft). See Figure 1-2 for a map of the INTEC at the INEEL.

1.4 Background and ICDF Description

DOE-ID authorized a RAWP for the INTEC in accordance with the Waste Area Group (WAG) 3, Operable Unit (OU) 3-13 Record of Decision (ROD) (DOE-ID 1999). The ROD requires the removal and on-Site disposal of some of the CERCLA-remediation wastes generated within the boundaries of the INEEL.

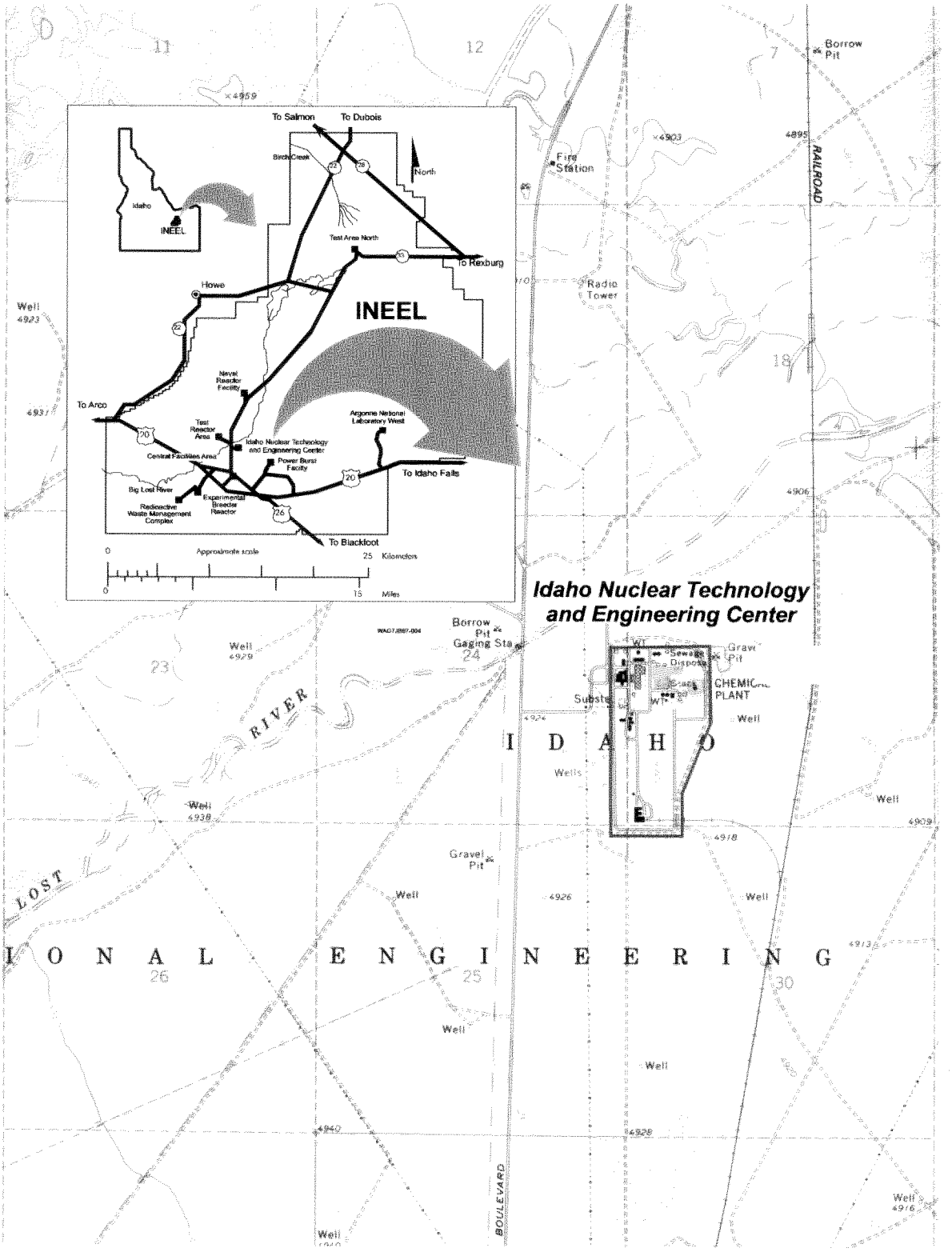

Figure 1-2. Map of the INTEC at the INEEL (topography adapted from U.S. Geological Survey Circular Butte 3SW, contour interval 10 ft, scale 1:24000).

The ROD requirements necessitate the construction of the ICDF, which will be the disposal facility for the ROD-identified waste streams. The ICDF is an on-Site, engineered facility, located south of INTEC and adjacent to the existing percolation ponds, that meets the substantive requirements of RCRA Subtitle C (42 USC 6921 et seq.), Idaho HWMA (HWMA 1983), DOE Order 435.1, and Toxic Substances Control Act (TSCA) polychlorinated biphenyl (PCB) landfill design and construction requirements (15 USC 2601 et seq.). Designed and authorized to accept not only WAG 3 wastes, but also wastes from other INEEL CERCLA actions, the ICDF Complex will include the necessary subsystems and support facilities to provide a complete waste disposal system.

The major components of the ICDF include

- The disposal cells (landfill)
- Two evaporation pond cells
- The Staging, Storage, Sizing, and Treatment Facility (SSSTF).

The ICDF Complex, including the SSSTF and a buffer zone, covers approximately 50 acres, with a disposal capacity of approximately 510,000 yd^3. The evaporation pond, designated as equivalent to a RCRA Corrective Action Management Unit (CAMU) in the OU 3-13 ROD, will be the disposal site for ICDF leachate and other aqueous wastes generated as a result of operating the ICDF Complex. It will also accept decontamination water and water from CERCLA-generated well purging, sampling, and well development activities. The ICDF leachate will be pumped directly to the evaporation pond, and the pump system will track the volume of waste disposed to the pond.

The SSSTF will be designed to provide the centralized receiving, inspection, treatment, and segregation areas necessary to stage and store incoming waste from the other INEEL CERCLA remediation sites prior to disposal to the ICDF landfill or shipment off-Site. All SSSTF activities shall take place within the WAG 3 area of contamination (AOC) to allow flexibility in managing the consolidation and remediation of wastes without triggering land disposal restrictions (LDRs) and other RCRA requirements, in accordance with the OU 3-13 ROD, although LDRs will apply to waste generated outside the WAG 3 AOC or to those wastes that have triggered placement. Figure 1-3 illustrates the WAG 3 AOC. Figure 1-4 illustrates the areas of the ICDF Complex.

A short-term storage/staging area, the Staging and Storage Annex (SSA), is already located within the INTEC fenced area to serve as a temporary storage or staging area for INEEL CERCLA waste designated for

- Direct disposal to the ICDF landfill
- Packaging in preparation for off-Site disposal
- Other INEEL on-Site disposal.

Wastes from WAG 3 and other CERCLA remediation sites will be stored at the SSA during the design and construction phases of the ICDF Complex, including the construction of the SSSTF. When the SSSTF becomes operational, the SSA will administratively become part of the SSSTF, which, in turn, will be a fundamental element of the ICDF Complex. The SSA waste acceptance must meet the Waste Acceptance Criteria (WAC) before it will be managed at the SSA.

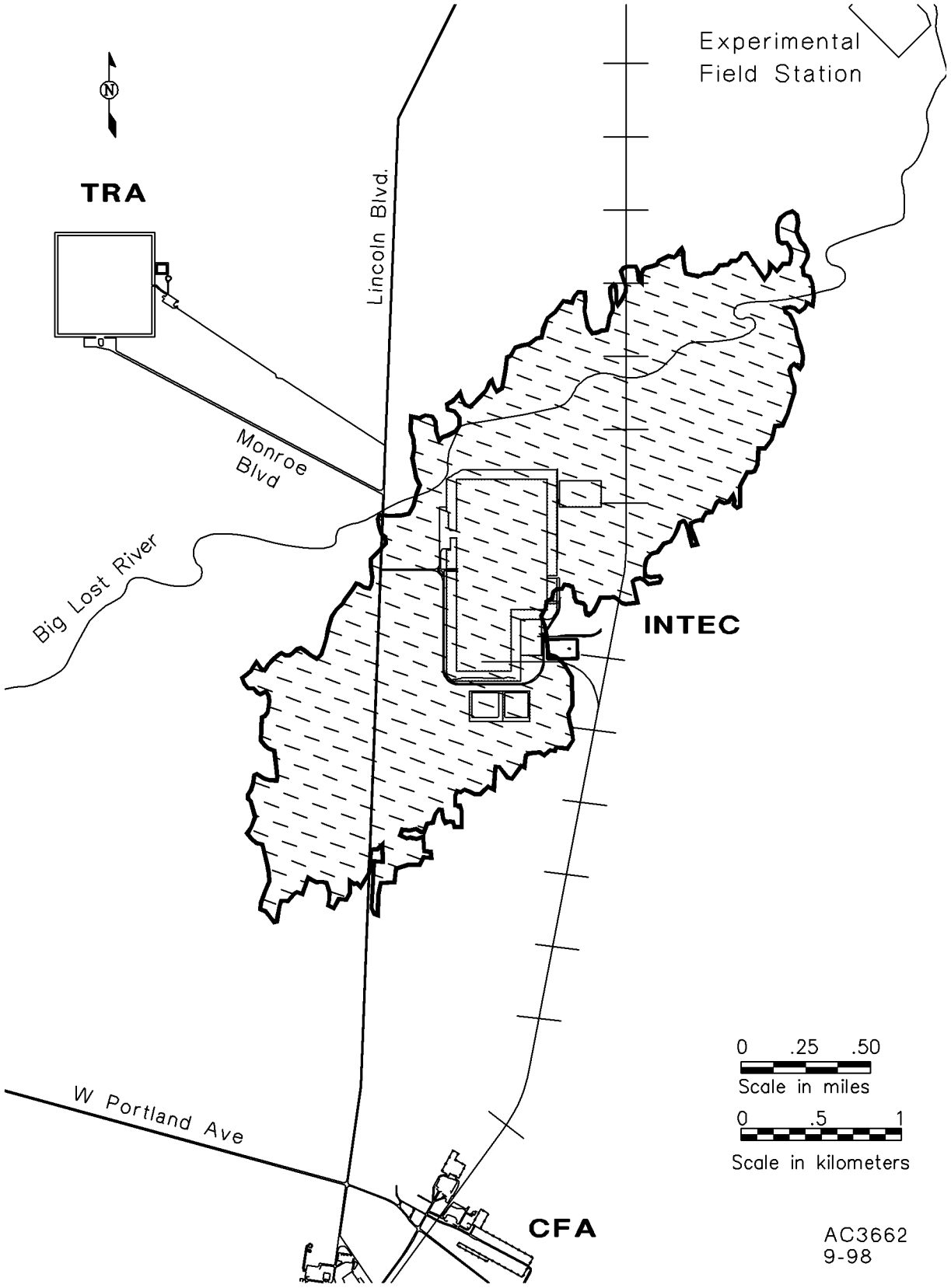

Figure 1-3. WAG 3 area of contamination.

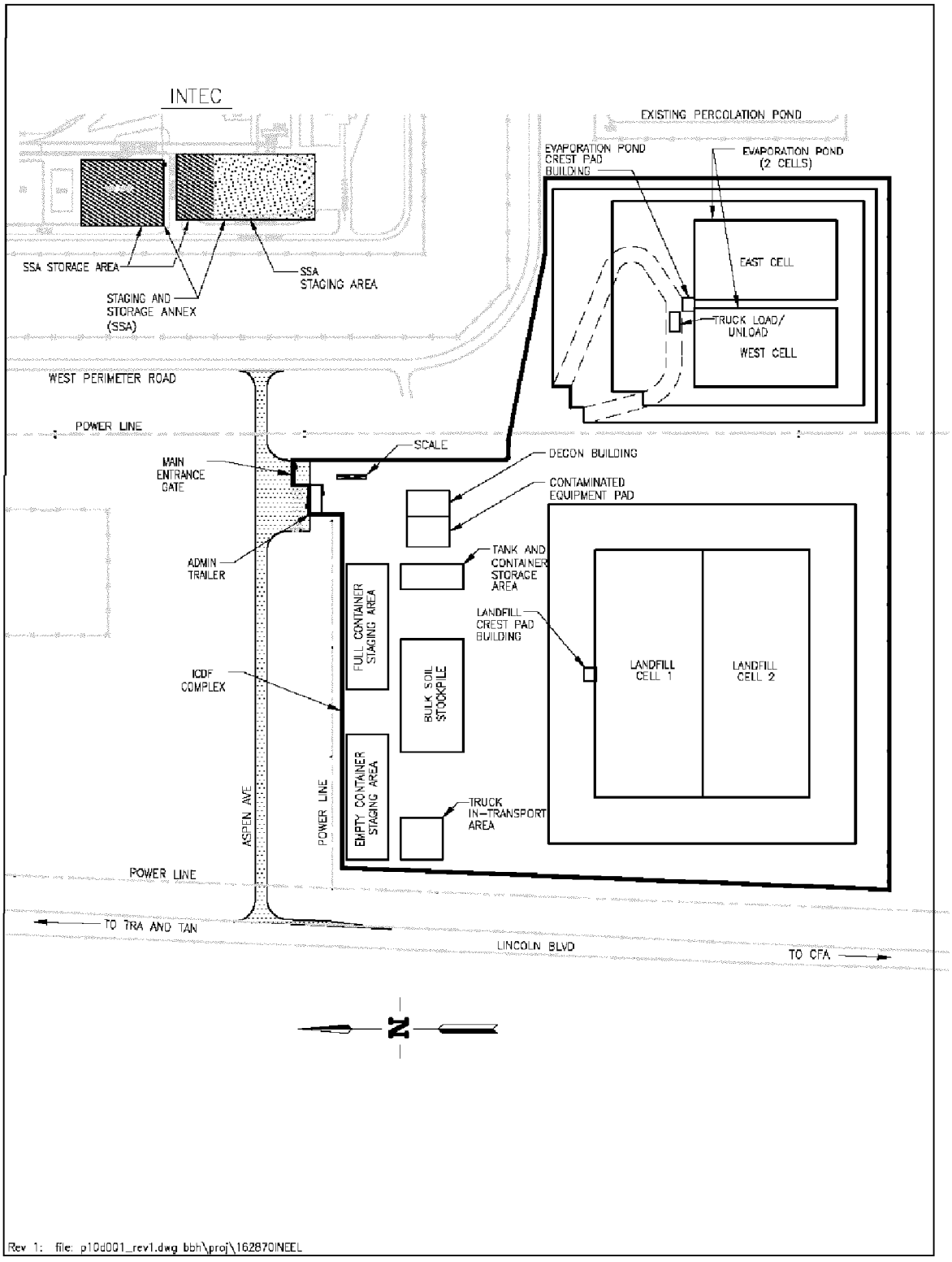

Figure 1-4. Location of the ICDF Complex components and proximity to the INTEC.

The evaporation pond, designated as equivalent to a CAMU in accordance with the substantive requirements of IDAPA 58.01.05.008 (40 CFR 264.552 and 40 CFR 264 Subparts K and CC), will accept and provide treatment/disposal capability for ICDF leachate; aqueous wastes generated as a result of operating the ICDF Complex (DOE-ID 1999); potentially contaminated aqueous waste streams generated from the INTEC and other INEEL CERCLA actions; and decontamination water and water from CERCLA-generated well purging, sampling, and well development activities. The ICDF leachate will be pumped directly to the evaporation pond, and the pump system will track the volume of waste disposed to the pond.

The SSSTF is the center for all waste handling and processing for the ICDF Complex. It is designed to provide centralized receiving, inspection, treatment, and segregation areas necessary to stage, store, and size incoming waste from various INEEL CERCLA remediation sites prior to ICDF disposal or shipment off-Site. Wastes meeting the ICDF WAC will be transported to the ICDF. Wastes that do not meet the ICDF WAC will be treated to meet the ICDF WAC, packaged for shipment off-Site, or transported to appropriate on-Site disposal. All SSSTF activities shall take place within the WAG 3 AOC to allow flexibility in managing the consolidation and remediation of wastes without triggering LDRs and other RCRA requirements, in accordance with the OU 3-13 ROD. However, LDRs will apply to waste generated outside the WAG 3 AOC or to those wastes that have triggered placement.

Currently, approximately 413,000 yd^3 (315,700 m^3) of INEEL CERCLA remediation waste, about 80% of the authorized capacity, have been identified for disposal in the ICDF during the first 10 years of operation. In addition to remediation waste, an additional 78 yd^3 (60 m^3) of IDW will be generated as part of the OU 3-14 tank farm investigation and disposed in the ICDF.

1.5 ICDF Components and Operations

Operational aspects of the ICDF Complex are described in the following sections. Each activity associated with ICDF operations will incorporate hazard identification and mitigation measures and follow applicable company policies and procedures.

1.5.1 Initial Waste Arrival at ICDF

Waste will arrive at the ICDF Complex from various on-Site INEEL CERCLA remediation sites. These sites and waste forms are grouped into the following categories: (1) landfill waste (waste meeting the ICDF landfill WAC without treatment), (2) stabilization waste (nonaqueous waste requiring stabilization in the SSSTF), (3) well development/purge water (aqueous waste from well purging and development activities), and (4) case-by-case waste (essentially waste that will require special handling procedures).

The access to the ICDF will initially be by an all-weather road with a maximum 10% grade, located on the southern, unlined portion of the excavation. This access road is wide enough to carry two-way traffic.

1.5.2 Waste Receipt

The waste receiving process includes the steps taken from the arrival of the waste at the SSSTF to disposal at the ICDF landfill or evaporation pond or to the staging of the waste prior to its transfer off-Site.

A Material Profile Sheet (MPS) for each waste container will have been approved by SSSTF/ICDF administrative personnel before arrival of the waste at the ICDF Complex gate. All required

fingerprinting of the waste will have been performed prior to shipment by the INEEL site generating the waste. Waste sent to the ICDF Complex must meet the appropriate components of the ICDF WAC (which includes the ICDF landfill WAC, the ICDF Complex WAC, and the ICDF evaporation pond WAC) to be accepted for processing in the ICDF Complex.

Validation of the waste shipment will include an initial inspection of the waste to determine whether it matches the identity of the waste specified on the MPS. This inspection will verify information such as an adequate MPS, actual number and type of containers matching the MPS, and intact containers. All waste loads will be validated (load inspection and quality assurance [QA] verification of load profile) to comply with QA guidelines and regulations, and pertinent information will be entered into the ICDF waste tracking system. Waste acceptance and receipt of soils destined for disposal in the ICDF landfill will also be dependent on the results of verification samples collected from the containerized waste to verify the waste matches the characteristics identified on the MPS. Verification sampling will be overseen by ICDF Complex personnel prior to acceptance of the waste at the ICDF Complex.

1.5.3 Weighing and Tracking

Waste entering or exiting the ICDF will be weighed and included in the waste tracking system at the weigh scale station. The weighing process shall have the capability to determine the weight of the waste vehicle being processed to comply with landfill standards for cell location and cell content. Additional tracking of the waste will be required during various treatment and staging/storage activities. On a case-by-case basis, some wastes will require additional tracking.

The weighing scale will be designed to accommodate a single truck containing either bulk waste or loaded with 13-yd^3, waste-laden, roll-off containers. Once the shipments have been weighed, pertinent information will be entered into an ICDF tracking system.

1.5.4 Waste Storage and Staging

After receiving the incoming waste shipments, the transport vehicles may deliver the loads directly to the ICDF landfill. Storage and staging areas are provided for a small number of containers of each waste type and bulk soil to allow for delays in processing and to stage waste for treatment.

1.5.5 Waste Treatment

The decon building provides treatment capabilities to treat INEEL CERCLA wastes and secondary waste streams generated during ICDF Complex operations, if needed. The purpose of treatment via stabilization is to prepare INEEL CERCLA waste that does not meet the ICDF landfill WAC for final disposal in the ICDF landfill or at an off-Site disposal facility. The object of stabilization is produce a treated waste that will (1) reduce the contaminant leachability to meet the ICDF landfill WAC and (2) exhibit no free liquid. The main components of the stabilization process are the vertical lift tipper, a mixer unit, a bulk-bag unloader, roll-on/roll-off container for collecting the treated waste from the mixer, and an air filtration system to collect particulates from the air.

Treatment of hazardous debris also will be performed at the decon building using Portland cement-based microencapsulation for debris wastes that require treatment prior to disposal. Microencapsulation encases the hazardous debris in inorganic materials (Portland cement concrete) to substantially reduce the surface exposure to potential leaching media. The components to the debris treatment process are the grout hopper/reservoir, positive displacement pump, hose, and box brace. Debris treatment equipment is portable and will be used in either the treatment area or decon bay of the decon building.

1.5.6 Disposal

Landfill wastes and treated stabilization wastes planned for disposal in the ICDF have unique characteristics for unloading, placement, and compaction. Waste material placement activities shall be conducted in a manner that protects and maintains the integrity of the liner system, leachate collection system, final cover system, and all ICDF Complex ancillary facilities and equipment.

The majority of the material sent for disposal in the ICDF will be bulk soils. These waste soils will be transported to the site in self-dumping vehicles. The placement of this material is expected to be accomplished by standard construction methods for unloading, spreading, grading, and compaction of soils unless already containerized. The trucks will be off-loaded under the direction of a field supervisor. Containerized waste may be placed within the landfill using other methods. Moisture treatment of the soil may be required to achieve adequate compaction. ICDF health, safety, and radiological support personnel will evaluate hazards from these operations and determine the appropriate controls.

Containers, including wooden and steel boxes and drums, will also be sent for disposal at the ICDF. The boxes may contain soil, stabilized soil material, scrap metal, and building debris. The boxes will be unloaded with specialized equipment. The containers will be placed so that the equipment used to spread the material can crush the boxes, which will allow their contents to be evenly spread and allow thorough compaction of the material.

Building demolition material will be sent to the ICDF. This material will be unloaded using specialized equipment, appropriate and consistent with operation procedures, and will be placed so that excessive localized void space will not be created.

The filling sequence will begin with 10-ft-thick layers built up in three layers to reach the crest of the excavation. The initial layer will consist of a 5-ft-thick select fill layer placed on top of the operation layer and then another 5-ft layer of general waste constructed over the initial layer. The next two 10-ft-thick layers will consist of general waste. Each of the 10-ft-thick layers will be constructed so that all the waste material is compacted into 1-ft-thick lifts. Each lift is placed, graded, and compacted until reaching the 10-ft-thick layer requirement. Actual fill sequence may vary based on volume and type of incoming fill.

Following removal of the waste material from the transport vehicle/container, the roll-off container or truck will be surveyed for external radiological contamination. Any truck that requires decontamination will decontaminated by first using dry techniques, with wet decontamination techniques used second to minimize generation of aqueous waste. Empty waste transfer vehicles or roll-off containers released by radiological control personnel will then return to the scales to be weighed and will leave the SSSTF through the gate.

1.5.7 Container Storage and Staging

After decontamination, the empty containers will be delivered to a staging pad for empty roll-off containers until they are required for further use. Empty drums and/or standard waste boxes (SWBs) will be sized or reused, as appropriate. Waste minimization applications will be implemented during this process.

1.5.8 Leachate Conveyance System

A leachate conveyance system has been incorporated into the design of the ICDF. This system transfers leachate from the landfill sumps to the evaporation pond. The operational activities associated with this system include

- Flow measurement
- Leak detection
- Instrument and equipment calibration
- Normal and emergency shutdown sequences
- Preventative maintenance
- Inspection
- Sampling and analysis
- Cleaning/sediment removal.

1.5.9 Evaporation Pond

The evaporation pond consists of two cells that accept aqueous wastes such as landfill leachate and other liquid waste sources from WAG 3 or from ICDF Complex operations. The water associated with the wastes will evaporate, leaving behind the solid materials. Routine tasks associated with management of the ICDF evaporation pond include pond cell washdown and transfer of aqueous waste to the evaporation pond. Additional nonroutine tasks are described in the ICDF Complex Operations and Maintenance Plan (DOE-ID 2003).

1.5.10 Additional ICDF Tasks

Additional tasks associated with ICDF operations include preventative maintenance, inspections, road maintenance, fencing inspection and repair, stormwater ditches/erosion control inspection, repair and maintenance, evaporation pond sampling, LCRS sampling, other routine sampling tasks, and groundwater monitoring. All ICDF operational activities will be evaluated to identify safety and health hazards and to determine the appropriate mitigation and control measures.

1.6 Program Interfaces

The interface agreement between the Environmental Restoration (ER) Program and the INTEC (IAG-89) describes the working relationships for activities and programs conducted by ER at the INTEC. The ER programs at INTEC are being conducted under the regulatory authority of the CERCLA (42 USC 6901 et seq.); the ROD for INTEC, WAG 3, OU 3-13 (DOE-ID 1999); and FFA/CO (DOE-ID 1991).

The ICDF operates as a facility under the purview of the SAD and is an INTEC facility. ICDF operations will be conducted in accordance with the ICDF ASA, this HASP, IAG-89, and ICDF operating procedures (standard and detailed).

2. HAZARD IDENTIFICATION AND MITIGATION

ICDF operations will involve the transportation, handling, storage, treatment, and disposal of approximately 413,000 yd^3 (315,700 m^3) of INEEL CERCLA waste and an additional 78 yd^3 (60 m^3) of IDW generated as part of the OU 3-14 tank farm investigation. This waste includes low-level, mixed low-level, hazardous, and limited quantities of TSCA-regulated waste. Operation of the ICDF will present physical, chemical, and radiological hazards to operations personnel, so identification and mitigation of these hazards is imperative to prevent injury or exposure to personnel conducting these activities. The primary objective of this section is to identify existing and anticipated hazards based on ICDF operations and to provide controls to eliminate or mitigate these hazards. This includes

- Evaluation of ICDF operations to determine the extent that potential industrial safety, radiological, nonradiological, and physical hazards may affect facility personnel
- Establishment of the necessary monitoring and sampling required to evaluate exposure and contamination levels, determine action levels to prevent exposures, and provide specific actions to be followed if action levels are reached
- Determination of necessary engineering controls, isolation methods, administrative controls, work practices, and (where these measures will not adequately control hazards) personal protective equipment (PPE) to further protect project personnel from hazards.

The purpose of this hazard identification section is to lead the user to an understanding of the occupational safety and health hazards associated with ICDF operational tasks. This will enable project management and safety and health professionals to make effective and efficient decisions related to the equipment, processes, procedures, and the allocation of resources to protect the safety and health of project personnel.

The magnitude of danger presented by these hazards to personnel entering work zones is dependent on both the nature of tasks being performed and the proximity of personnel to the hazards. Engineering controls will be implemented (whenever possible) along with administrative controls, work practices, and PPE to further mitigate potential exposures and hazards. This following section describes the chemical, radiological, safety, and environmental hazards that personnel may encounter while conducting ICDF operational activities. Hazard mitigation provided in this section in combination with other work controls (e.g., technical procedures, work orders, JSA, and applicable company policies and procedures also will be used where applicable to eliminate or mitigate project hazards.

2.1 Chemical and Radiological Hazards and Mitigation

Personnel may be exposed to industrial safety hazards or to radiological, nonradiological, and physical agents while conducting ICDF operations. Engineering controls will be implemented (whenever possible), along with adequate work practice controls (administrative), real-time monitoring of personnel exposure to contaminants, and ICDF facility-specific hazard training to further mitigate potential hazards and exposures. Formal preplanning (job walk-down, completion of the hazard profile screening checklist, and prejob briefing checklist), written procedures, JSAs, and other work controls will be written based on the hazards identified in this HASP, technical procedures, applicable company policies and procedures work packages, and facility-specific conditions. These documents will specify operational hazard mitigation measures to follow.

The ICDF Short Term Risk Assessment (EDF-ER-327) identifies three chemicals which exceed the hazard index for noncancer effects to the evaporation pond operator. The hazard index for noncancer

effects for the evaporation pond operator is 4; the primary contributors to noncancer risk are 2-nitroaniline, 3-nitroaniline, and 4-nitroaniline. These materials will remain in solution due to their solubility. Evaporated liquids will tend to leave precipitous materials (contaminated) behind the nitroanaline compounds. To avoid personnel exposure to these compounds, personnel will be restricted from skin contact which is the primary exposure route of these compounds. Pond cleaning and handling procedures will specifically address the potential hazards and mitigations during pond sediment handling operations. Initial and periodic sampling may be instituted by the facility IH to ensure the effectiveness of instituted control measures.

Several tables are presented in this section that identify the potential hazards that may be encountered during ICDF operations based on known waste inventory, monitoring methods, and other hazard-specific mitigation measures. These include

Table 2-1, ICDF waste radionuclide inventory

Table 2-2, ICDF organic and inorganic waste inventory

Table 2-3, Evaluation of chemical agents that may be encountered at the ICDF

Table 2-4, Summary of ICDF operational activities, associated hazards, and mitigation

Table 2-5, ICDF operations – radiological and nonradiological hazards to be monitored

Table 2-6, Typical equipment available for monitoring radiological and nonradiological hazards

Table 2-7, Exposure limits for select ICDF operational hazards and corresponding response.

Table 2-1. ICDF waste radionuclide inventory[a,b].

Radionuclide	Half-life	Contaminated Soil Volume (m^3)[c]	Activity (Ci) (1/1/2002)	Radionuclide	Half-life	Contaminated Volume Soil (m^3)[c]	Activity (Ci) (1/1/2002)
H-3	1.23E+01	312,598	2.3E+01	Rh-106	9.51E-07	312,598	5.4E-03
Be-10	1.60E+06	312,598	5.4E-07	Ag-106	4.56E-05	312,598	0.0E+00
C-14	5.73E+03	312,598	2.2E-05	Pd-107	6.50E+06	312,598	2.9E-03
K-40	1.28E+09	312,598	9.1E-01	Ag-108	4.51E-06	312,598	1.8E-09
Sc-46	2.30E-01	312,598	1.3E-20	**Ag-108m**	1.27E+02	312,598	3.8E-01
Cr-51	7.39E-02	312,598	1.1E-54	Ag-109m	1.25E-06	312,598	2.3E-12
Mn-54	8.56E-01	312,598	9.1E-09	Cd-109	1.27E+00	312,598	2.3E-12
Co-57	7.42E-01	312,598	1.7E-03	Ag-110	7.79E-07	312,598	2.5E-11
Co-58	1.94E-01	312,598	2.8E-17	Ag-110m	6.84E-01	312,598	2.6E-09
Fe-59	1.22E-01	312,598	2.1E-35	Ag-111	2.04E-02	312,598	0.0E+00
Co-60	5.27E+00	312,598	9.2E+01	Cd-113m	1.37E+01	312,598	7.7E-01
Zn-65	6.69E-01	312,598	1.3E-09	In-114	2.28E-06	312,598	8.9E-55
Se-79	6.50E+04	312,598	7.9E-02	In-114m	1.36E-01	312,598	9.4E-55
Kr-81	2.10E+05	312,598	2.5E-09	Cd-115m	1.22E-01	312,598	2.0E-54
Kr-85	1.07E+01	312,598	5.5E+02	In-115	4.60E+15	312,598	2.7E-12
Rb-86	5.11E-02	312,598	0.0E+00	In-115m	5.12E-04	312,598	0.0E+00

Table 2-1. (continued).

Radionuclide	Half-life	Contaminated Soil Volume (m^3)[c]	Activity (Ci) (1/1/2002)	Radionuclide	Half-life	Contaminated Volume Soil (m^3)[c]	Activity (Ci) (1/1/2002)
Rb-87	4.73E+10	312,598	5.3E-06	Sn-117m	3.72E-02	312,598	0.0E+00
Sr-89	1.38E-01	312,598	2.8E-44	Sn-119m	8.02E-01	312,598	7.0E-08
Sr-90	2.86E+01	312,598	1.1E+04	Sn-121m	7.60E+01	312,598	1.3E-02
Y-90	7.31E-03	312,598	1.1E+04	Sn-123	3.54E-01	312,598	4.0E-17
Y-91	1.60E-01	312,598	2.0E-37	Te-123	1.00E+13	312,598	2.1E-15
Nb-92	3.60E+07	312,598	3.0E-19	Te-123m	3.28E-01	312,598	1.4E-23
Zr-93	1.53E+06	312,598	4.1E-01	Sb-124	1.65E-01	312,598	9.8E-41
Nb-93m	1.46E+01	312,598	6.4E-03	Sn-125	2.64E-02	312,598	0.0E+00
Nb-94	2.03E+04	312,598	4.2E-06	**Sb-125**	2.77E+00	312,598	4.4E+00
Zr-95	1.75E-01	312,598	1.4E-25	Te-125m	1.59E-01	312,598	1.1E+00
Nb-95	9.60E-02	312,598	2.3E-33	Sn-126	1.00E+05	312,598	7.0E-02
Nb-95m	9.88E-03	312,598	8.7E-36	Sb-126	1.24E+01	312,598	9.8E-03
Tc-98	4.20E+06	312,598	8.4E-08	Sb-126m	3.61E-05	312,598	7.0E-02
Tc-99	2.13E+05	312,598	2.7E+00	Te-127	1.07E-03	312,598	4.4E-20
Rh-102	2.90E+00	312,598	1.4E-05	Te-127m	2.98E-01	312,598	4.5E-20
Ru-103	1.08E-01	312,598	9.5E-30	Xe-127	9.97E-02	312,598	7.5E-73
Rh-103m	1.07E-04	312,598	1.3E-58	Te-129	1.32E-04	312,598	3.2E-71
Ru-106	1.01E+00	312,598	5.8E-03	Te-129m	9.20E-02	312,598	5.1E-71
I-129	1.57E+07	312,598	6.1E-01	**Eu-155**	4.96E+00	312,598	8.4E+01
Xe-129m	2.43E-02	312,598	0.0E+00	Eu-156	4.16E-02	312,598	0.0E+00
I-131	2.20E-02	312,598	0.0E+00	Tb-160	1.98E-01	312,598	1.5E-34
Xe-131m	3.24E-02	312,598	1.3E-112	Tb-161	1.89E-02	312,598	0.0E+00
Cs-132	1.77E-02	312,598	0.0E+00	Ho-166m	1.20E+03	312,598	1.3E-06
Xe-133	1.44E-02	312,598	0.0E+00	Er-169	2.57E-02	312,598	0.0E+00
Cs-134	2.06E+00	312,598	5.3E+00	Tm-170	3.52E-01	312,598	3.0E-26
Cs-135	2.30E+06	312,598	1.7E-02	Tm-171	1.92E+00	312,598	7.6E-13
Cs-136	3.60E-02	312,598	0.0E+00	Hf-181	1.16E-01	312,598	3.7E-37
Ba-136m	1.01E-08	312,598	0.0E+00	Tl-207	9.07E-06	312,598	8.7E-06
Cs-137	3.02E+01	312,598	1.2E+04	Tl-208	5.80E-06	312,598	9.4E-05
Ba-137m	4.85E-06	312,598	1.1E+04	Tl-209	4.18E-06	312,598	5.0E-10
La-138	stable	312,598	0.0E+00	Pb-209	3.71E-04	312,598	2.3E-08
Ba-140	3.50E-02	312,598	0.0E+00	Pb-210	2.23E+01	312,598	5.2E-07
La-140	4.59E-03	312,598	1.3E-105	Pb-211	6.86E-05	312,598	8.7E-06
Ce-141	8.90E-02	312,598	8.5E-72	Pb-212	1.21E-03	312,598	2.6E-04
Ce-142	stable	312,598	0.0E+00	Pb-214	5.10E-05	312,598	2.7E-06

Table 2-1. (continued).

Radionuclide	Half-life	Contaminated Soil Volume (m^3)[c]	Activity (Ci) (1/1/2002)	Radionuclide	Half-life	Contaminated Volume Soil (m^3)[c]	Activity (Ci) (1/1/2002)
Pr-143	3.71E-02	312,598	0.0E+00	Bi-210	1.37E-02	312,598	5.2E-07
Ce-144	7.78E-01	312,598	8.6E-04	Bi-211	4.05E-06	312,598	8.7E-06
Pr-144	3.29E-05	312,598	8.4E-04	Bi-212	1.15E-04	312,598	2.6E-04
Pr-144m	1.37E-05	312,598	1.2E-05	Bi-213	8.68E-05	312,598	0.0E+00
Nd-144	5.00E+15	312,598	1.5E-10	Bi-214	3.78E-05	312,598	2.7E-06
Pm-146	5.53E+00	312,598	2.8E-03	Po-210	3.79E-01	312,598	4.8E-07
Sm-146	7.00E+07	312,598	2.0E-10	Po-211	1.64E-08	312,598	3.2E-10
Nd-147	3.01E-02	312,598	0.0E+00	Po-212	9.44E-15	312,598	1.6E-04
Pm-147	2.62E+00	312,598	1.8E+02	Po-213	1.33E-13	312,598	2.1E-08
Sm-147	1.06E+11	312,598	1.9E-06	Po-214	5.20E-12	312,598	2.7E-06
Pm-148	1.47E-02	312,598	1.9E-59	Po-215	6.34E-11	312,598	8.7E-06
Pm-148m	1.13E-01	312,598	3.9E-58	Po-216	4.63E-09	312,598	2.6E-04
Sm-148	1.20E+13	312,598	4.8E-13	Po-218	5.80E-06	312,598	2.7E-06
Sm-149	4.00E+14	312,598	2.4E-12	At-217	1.01E-09	312,598	2.4E-08
Eu-150	5.00E+00	312,598	8.2E-09	Rn-218	1.11E-09	312,598	6.0E-117
Sm-151	9.00E+01	312,598	1.6E+02	Rn-219	1.25E-07	312,598	9.6E-06
Eu-152	1.36E+01	312,598	4.6E+02	Rn-220	1.76E-06	312,598	2.6E-04
Gd-152	1.10E+14	312,598	1.3E-14	Rn-222	1.05E-02	312,598	2.9E-06
Gd-153	6.61E-01	312,598	9.5E-12	Fr-221	9.13E-06	312,598	2.4E-08
Eu-154	8.80E+00	312,598	3.9E+02	Fr-223	4.14E-05	312,598	1.3E-07
Ra-222	1.20E-06	312,598	5.5E-117	Np-239	6.45E-03	312,598	1.6E-04
Ra-223	3.13E-02	312,598	9.6E-06	Np-240	1.24E-04	312,598	1.3E-14
Ra-224	9.91E-03	312,598	2.6E-04	Np-240m	1.41E-05	312,598	1.2E-11
Ra-225	4.05E-02	312,598	2.4E-08	Pu-236	2.85E+00	312,598	2.6E-06
Ra-226	1.60E+03	312,598	2.2E-01	Pu-237	1.24E-01	312,598	5.7E-59
Ra-228	5.75E+00	312,598	7.2E-11	**Pu-238**	8.78E+01	312,598	1.1E+02
Ac-225	2.74E-02	312,598	2.4E-08	**Pu-239**	2.41E+04	312,598	3.2E+00
Ac-227	2.18E+01	312,598	9.7E-06	**Pu-240**	6.57E+03	312,598	7.1E-01
Ac-228	6.99E-04	312,598	7.2E-11	Pu-241	1.44E+01	312,598	3.0E+01
Th-226	5.87E-05	312,598	1.0E-117	Pu-242	3.76E+05	312,598	1.1E-04
Th-227	5.13E-02	312,598	8.6E-06	Pu-243	5.65E-04	312,598	3.0E-16
Th-228	1.91E+00	312,598	1.6E-02	Pu-244	8.26E+07	312,598	1.2E-11
Th-229	7.34E+03	312,598	2.4E-08	Pu-246	2.97E-02	312,598	6.5E-26
Th-230	7.70E+04	312,598	8.2E-02	**Am-241**	4.32E+02	312,598	1.1E+01
Th-231	2.91E-03	312,598	7.6E-02	Am-242m	1.52E+02	312,598	2.1E-05

Table 2-1. (continued).

Radionuclide	Half-life	Contaminated Soil Volume (m^3)[c]	Activity (Ci) (1/1/2002)	Radionuclide	Half-life	Contaminated Volume Soil (m^3)[c]	Activity (Ci) (1/1/2002)
Th-232	1.40E+10	312,598	7.4E-02	Am-242	1.83E-03	312,598	2.1E-05
Th-234	6.60E-02	312,598	8.1E-04	Am-243	7.38E+03	312,598	1.6E-04
Pa-231	3.73E+04	312,598	3.3E-05	Am-245	2.40E-04	312,598	0.0E+00
Pa-233	7.39E-02	312,598	2.1E-02	Am-246	4.75E-05	312,598	6.5E-26
Pa-234m	2.22E-06	312,598	8.1E-04	Cm-241	9.58E-02	312,598	6.1E-81
Pa-234	7.64E-04	312,598	1.3E-06	Cm-242	4.47E-01	312,598	2.6E-17
U-230	5.69E-02	312,598	0.0E+00	Cm-243	2.85E+01	312,598	1.7E-06
U-232	7.20E+01	312,598	2.5E-04	Cm-244	1.81E+01	312,598	8.5E-04
U-233	1.59E+05	312,598	1.2E-05	Cm-245	8.50E+03	312,598	3.8E-08
U-234	2.44E+05	312,598	2.9E+00	Cm-246	4.75E+03	312,598	8.5E-10
U-235	7.04E+08	312,598	5.2E-02	Cm-247	1.56E+07	312,598	3.0E-16
U-236	2.34E+07	312,598	9.6E-02	Cm-248	3.39E+05	312,598	9.3E-17
U-237	1.85E-02	312,598	0.0E+00	Cm-250	6.90E+03	312,598	2.6E-25
U-238	4.47E+09	312,598	9.2E-01	Bk-249	8.76E-01	312,598	1.0E-21
U-240	1.61E-03	312,598	1.2E-11	Bk-250	3.68E-04	312,598	3.7E-26
Np-235	1.08E+00	312,598	3.2E-11	Cf-249	3.51E+02	312,598	2.0E-16
Np-236	1.15E+05	312,598	3.3E-08	Cf-250	1.31E+01	312,598	1.0E-16
Np-237	2.14E+06	312,598	3.0E-01	Cf-251	9.00E+02	312,598	4.5E-19
Np-238	5.80E-03	312,598	1.0E-07	Cf-252	2.64E+00	312,598	1.1E-20

a. EDF-ER-264, "INEEL CERCLA Disposal Facility Design Inventory."

b. Bold indicates radionuclides that have been detected at the INEEL release sites.

c. The contaminated soil volume includes all release sites except CPP-44, CPP-55, CPP-93, and TSF-03, where radiological contamination is not expected based on process knowledge.

Table 2-2. Organic and inorganic waste inventory[a,b].

Organic Waste				
Contaminant	CAS Number	Contaminated Soil (m^3)	Contaminant Mass (kg)	Maximum Concentration[a] (mg/kg)
1,1,1-Trichloroethane	71-55-6	215,247	7.4E+00	3.30E-02
1,1,2,2-Tetrachloroethane	79-34-5	7,811	2.3E-02	2.00E-03
1,1,2-Trichloroethane	76-13-1	8,494	1.1E-01	9.00E-03
1,1-Dichloroethane	75-34-3	8,494	1.1E+00	8.70E-02
1,1-Dichloroethene	75-35-4	8,494	7.0E-01	5.50E-02
1,2,4-Trichlorobenzene	120-82-1	7,811	5.4E+00	4.60E-01
1,2-Dichlorobenzene	95-50-1	7,811	5.4E+00	4.60E-01
1,2-Dichloroethane	107-06-2	8,494	2.5E-03	2.00E-04
1,2-Dichloroethene (total)	540-59-0	14,887	1.5E-01	1.20E-02
1,3-Dichlorobenzene	541-73-1	7,811	5.4E+00	4.60E-01
1,4-Dichlorobenzene	106-46-7	24,750	2.1E+02	1.60E+01
1,4-Dioxane	123-91-1	54	8.9E-03	1.10E-01
2,4,5-Trichlorophenol	95-95-4	14,199	2.1E+01	1.10E+00
2,4,6-Trichlorophenol	88-06-2	14,199	8.6E+00	4.60E-01
2,4-Dichlorophenol	120-83-2	16,305	1.0E+01	4.60E-01
2,4-Dimethylphenol	105-67-9	14,199	8.6E+00	4.60E-01
2,4-Dinitrophenol	51-28-5	15,702	2.4E+01	1.33E+00
2,4-Dinitrotoluene	121-14-2	7,811	5.4E+00	4.60E-01
2,6-Dinitrotoluene	606-20-2	14,199	9.8E+00	4.60E-01
2-Butanone	78-93-3	51,377	1.2E+01	4.11E-01
2-Chloronaphthalene	91-58-7	7,811	5.4E+00	4.60E-01
2-Chlorophenol	95-57-8	14,199	8.6E+00	4.60E-01
2-Hexanone	591-78-6	33,153	1.3E+00	4.10E-02
2-Methylnaphthalene	91-57-6	23,155	2.4E+02	1.03E+01
2-Methylphenol	95-48-7	29,543	9.8E+00	4.60E-01
2-Nitroaniline	88-74-4	7,811	1.3E+01	1.10E+00
2-Nitrophenol	88-75-5	14,199	8.6E+00	4.60E-01
3,3'-Dichlorobenzidine	91-94-1	7,811	5.4E+00	4.60E-01
3-Methyl butanal	590-86-3	8,494	1.1E-01	8.30E-03
3-Nitroaniline	99-09-2	7,811	1.3E+01	1.10E+00

Table 2-2. (continued).

Organic Waste				
Contaminant	CAS Number	Contaminated Soil (m^3)	Contaminant Mass (kg)	Maximum Concentration[a] (mg/kg)
4,6-Dinitro-2-methylphenol	534-52-1	14,199	2.1E+01	1.10E+00
4-Bromophenyl-phenylether	101-55-3	7,811	5.4E+00	4.60E-01
4-Chloro-3-methylphenol	59-50-7	14,199	8.6E+00	4.60E-01
4-Chloroaniline	106-47-8	16,256	1.9E+01	1.10E+00
4-Chlorophenyl-phenylether	7005-72-3	7,811	5.4E+00	4.60E-01
4-Methyl-2-pentanone	108-10-1	225,513	1.4E+01	1.00E-01
4-Methylphenol	106-44-5	22,644	1.8E+01	7.60E-01
p-Nitroaniline	100-01-6	7,811	1.3E+01	1.10E+00
4-Nitrophenol	100-02-7	22,644	2.4E+01	1.10E+00
Acenaphthene	83-32-9	109,970	9.6E+01	2.60E+00
Acenaphthylene	208-96-8	14,199	9.8E+00	4.60E-01
Acetone	67-64-1	243,367	2.9E+02	4.20E+00
Acetonitrile	75-05-8	54	8.9E-03	1.10E-01
Acrolein	107-02-8	54	4.3E-03	5.30E-02
Acrylonitrile	107-13-1	54	4.3E-03	5.30E-02
Anthracene	120-12-7	185,860	1.5E+02	5.30E+00
Aramite	140-57-8	54	5.4E-02	6.70E-01
Aroclor-1016	12674-11-2	6,388	3.6E+00	3.80E-01
Aroclor-1254	11097-69-1	96,545	6.1E+01	2.80E+00
Aroclor-1260	11096-82-5	100,155	3.4E+02	2.30E+01
Aroclor-1268	11100-14-4	16,439	2.9E+01	1.23E+00
Benzene	71-43-2	208,328	2.9E+02	9.34E-01
Benzidine	92-87-5	54	1.4E-01	1.70E+00
Benzo(a)anthracene	56-55-3	194,359	1.2E+02	1.50E+00
Benzo(a)pyrene	50-32-8	93,650	5.0E+01	4.60E-01
Benzo(b)fluoranthene	205-99-2	100,640	8.5E+01	2.00E+00
Benzo(g,h,i)perylene	191-24-2	7,811	5.4E+00	4.60E-01
Benzo(k)fluoranthene	207-08-9	16,256	8.8E+00	4.60E-01
Benzoic acid	65-85-0	8,445	4.1E+00	3.20E-01
bis(2-Chloroethoxy)methane	111-91-1	7,811	5.4E+00	4.60E-01
bis(2-Chloroethyl)ether	111-44-4	7,811	5.4E+00	4.60E-01

Table 2-2. (continued).

Organic Waste				
Contaminant	CAS Number	Contaminated Soil (m^3)	Contaminant Mass (kg)	Maximum Concentration[a] (mg/kg)
bis(2-Chloroisopropyl)ether	108-60-1	7,811	5.4E+00	4.60E-01
bis(2-Ethylhexyl)phthalate	117-81-7	115,622	7.0E+01	1.70E+00
Butane,1,1,3,4-tetrachloro-	Unknown	6,388	3.7E+00	3.90E-01
Butylbenzylphthalate	85-68-7	16,359	3.2E+01	2.10E+00
Carbazole	86-74-8	38,091	1.5E+01	4.60E-01
Carbon disulfide	75-15-0	208,328	2.2E+01	1.40E-01
Chlorobenzene	108-90-7	8,494	3.1E+00	2.44E-01
Chloroethane	75-00-3	68	1.4E-03	1.40E-02
Chloromethane	74-87-3	16,305	1.7E-01	1.10E-02
Chrysene	218-01-9	194,359	1.3E+02	1.60E+00
Decane, 3,4-dimethyl	173-124-57	8,494	7.6E-02	6.00E-03
Diacetone alcohol	123-42-2	6,388	2.0E+03	2.14E+02
Dibenz(a,h)anthracene	53-70-3	7,811	5.4E+00	4.60E-01
Dibenzofuran	132-64-9	31,650	1.5E+02	4.50E+00
Diethylphthalate	84-66-2	7,865	5.4E+00	4.60E-01
Dimethyl disulfide	624-92-0	8,494	1.4E+00	1.10E-01
Dimethylphthalate	131-11-3	7,811	5.4E+00	4.60E-01
Di-n-butylphthalate	84-74-2	42,267	1.1E+01	4.50E+00
Di-n-octylphthalate	117-84-0	22,698	1.2E+01	4.60E-01
Eicosane	112-95-8	6,388	1.3E+00	1.40E-01
Ethyl cyanide	107-12-0	54	8.9E-03	1.10E-01
Ethylbenzene	100-41-4	31,704	3.7E+01	1.27E+00
Famphur	52-85-7	54	2.8E-02	3.40E-01
Fluoranthene	206-44-0	194,359	3.6E+02	6.90E+00
Fluorene	86-73-7	109,970	8.7E+01	4.90E+00
Heptadecane, 2,6,10,15-tetra	Unknown	6,388	1.6E+00	1.70E-01
Hexachlorobenzene	118-74-1	7,811	5.4E+00	4.60E-01
Hexachlorobutadiene	87-68-3	14,199	9.8E+00	4.60E-01
Hexachlorocyclopentadiene	77-47-4	7,811	5.4E+00	4.60E-01
Hexachloroethane	67-72-1	7,811	5.4E+00	4.60E-01
Indeno(1,2,3-cd)pyrene	193-39-5	7,811	5.4E+00	4.60E-01

Table 2-2. (continued).

Organic Waste				
Contaminant	CAS Number	Contaminated Soil (m^3)	Contaminant Mass (kg)	Maximum Concentration[a] (mg/kg)
Isobutyl alcohol	78-83-1	54	8.9E-03	1.10E-01
Isophorone	78-59-1	7,865	5.4E+00	4.60E-01
Isopropyl alcohol/2-propanol	67-63-0	9,572	1.0E+00	7.00E-02
Kepone	143-50-0	78,320	4.7E+01	4.00E-01
Mesityl oxide	141-79-7	6,388	4.0E+01	4.19E+00
Methyl acetate	79-20-9	8,494	2.3E-01	1.80E-02
Methylene chloride	75-09-2	204,802	4.0E+01	2.90E-01
Naphthalene	91-20-3	31,601	2.0E+02	7.80E+00
Nitrobenzene	98-95-3	7,811	5.4E+00	4.60E-01
N-Nitroso-di-n-propylamine	621-64-7	7,811	5.4E+00	4.60E-01
N-Nitrosodiphenylamine	86-30-6	7,811	5.4E+00	4.60E-01
Octane,2,3,7-trimethyl	62016-34-6	8,494	7.6E-02	6.00E-03
o-Toluenesulfonamide	88-19-7	6,388	2.4E+00	2.50E-01
Pentachlorophenol	87-86-5	31,138	2.6E+01	1.10E+00
Phenanthrene	85-01-8	194,360	5.5E+02	1.60E+01
Phenol	108-95-2	22,698	3.8E+01	2.30E+00
Phenol,2,6-Bis(1,1-dimethyl)	Unknown	6,388	1.9E+00	2.00E-01
p-Toluenesulfonamide	70-55-3	6,388	2.4E+00	2.50E-01
Pyrene	129-00-0	103,124	1.2E+02	6.40E+00
Styrene	100-42-5	54	4.9E-04	6.00E-03
Tetrachloroethene	127-18-4	224,494	4.6E+00	1.30E-01
Toluene	108-88-3	239,746	4.7E+02	8.33E+00
Tributylphosphate	126-73-8	249,578	1.7E+02	4.60E-01
Trichloroethene	79-01-6	227,010	3.4E+01	2.00E-01
Undecane,4,6-dimethyl-	17312822	8,494	7.6E-02	6.00E-03
Xylene (ortho)	95-47-6	245,243	1.8E+00	5.00E-03
Xylene (total)	1330-20-7	231,537	1.6E+03	4.30E+01
Ytterbium	7440-64-4	42,164	9.2E+04	4.00E+03

Table 2-2. (continued).

Inorganic Waste				
Contaminant	CAS Number	Contaminated Soil (m^3)	Contaminant Mass (kg)	Maximum Concentration[a] (mg/kg)
Aluminum	7429-90-5	278,436	3.4E+06	6.53E+04
Antimony	7440-36-0	75,353	2.8E+03	1.71E+02
Arsenic	7440-38-2	261,562	2.7E+03	4.92E+01
Barium	7440-39-3	260,447	8.5E+04	9.74E+03
Beryllium	7440-41-7	173,589	1.4E+02	1.80E+00
Boron	7440-42-8	256,177	8.7E+04	4.19E+02
Cadmium	7440-43-9	275,081	1.7E+03	2.67E+01
Calcium	7440-70-2	264,122	9.7E+06	1.33E+05
Chloride	16887-00-6	256,146	8.8E+02	4.00E+00
Chromium	7440-47-3	260,785	1.9E+04	1.54E+03
Cobalt	7440-48-4	264,122	2.9E+03	1.04E+02
Copper	7440-50-8	264,122	1.4E+04	3.20E+02
Cyanide	57-12-5	42,390	1.6E+02	3.40E+00
Dysprosium	7429-91-6	42,164	2.8E+04	1.21E+03
Fluoride	16984-48-8	256,177	1.8E+03	2.64E+02
Iron	7439-89-6	264,122	4.9E+06	3.37E+04
Lead	7439-92-1	264,122	2.7E+04	2.82E+03
Magnesium	7439-95-4	264,122	2.1E+06	3.04E+04
Manganese	7439-96-5	264,122	9.8E+04	1.40E+03
Mercury	7439-97-6	260,785	4.5E+03	7.38E+01
Molybdenum	7439-98-7	256,177	4.8E+03	2.27E+01
Nickel	7440-02-0	264,122	9.3E+03	3.44E+02
Nitrate	7697-37-2	262,565	1.9E+03	3.30E+03
Nitrate/Nitrite-N	7727-37-9	2,265	1.1E+02	3.38E+01
Nitrite	14797-65-0	9,572	4.0E+00	2.80E-01
Phosphorus	7723-14-0	42,164	4.6E+04	8.98E+02
Potassium	7440-09-7	264,122	5.3E+05	3.91E+03
Selenium	7782-49-2	257,937	4.0E+02	1.01E+01
Silver	7440-22-4	217,607	4.7E+03	2.95E+02
Sodium	7440-23-5	264,122	1.0E+05	1.24E+03
Strontium	7440-24-6	42,164	8.6E+03	3.30E+02

Table 2-2. (continued).

Inorganic Waste				
Contaminant	CAS Number	Contaminated Soil (m^3)	Contaminant Mass (kg)	Maximum Concentration[a] (mg/kg)
Sulfate	14808-79-8	256,177	9.7E+03	6.40E+01
Sulfide	18496-25-8	29,407	3.6E+05	2.80E+04
Terbium	7440-27-9	42,164	2.7E+05	1.18E+04
Thallium	7440-28-0	134,041	1.8E+02	8.42E+01
Vanadium	7440-62-2	264,122	1.0E+04	1.04E+02
Zinc	7440-66-6	173,582	9.9E+04	6.09E+03
Zirconium	7440-67-7	262,565	3.3E+04	2.00E+02

a. Maximum concentration identified in DOE-ID (2000).

b. EDF-ER-264, "INEEL CERCLA Disposal Facility Design Inventory."

Table 2-3. Evaluation of chemical agents that may be encountered at the ICDF.

Material or Chemical (CAS #, Vapor Density & Ionization Energy)[a]	Exposure Limit[b] (PEL/TLV)	Routes of Exposure[c]	Indicators or Symptoms of Over-Exposure[d] (Acute and Chronic)	Target Organs/System	Carcinogen? (source)[e]	Exposure Potential (all routes without regard to PPE)
ORGANIC COMPOUNDS						
Diesel fuel (8008-20-6)	TLV 100 mg/m^3 (ACGIH 2000 notice of intended changes)	Ih, Ig, S, Con	Eye irritation; respiratory system changes; dermatitis	Eye, respiratory system	No	Moderate potential. Will be used to refuel equipment.
Diesel exhaust (particulate aerodynamic diameter < 1 μm)	TLV-TWA: 0.05 mg/m^3 (ACGIH 2000 notice of intended changes)	Ih	Respiratory, nose, throat or lung irritation with stinging and redness of the eyes; headache; nausea; dizziness; unconsciousness	Respiratory system	A2 – ACGIH	Moderate potential. Numerous exhaust sources at the ICDF area.
1,1,1-Trichloroethane	TWA: 350 ppm (1900 mg/m^3)	Ih, Ig, Con	Eye and skin irritation; headache, lassitude, central nervous system depressant/depression, poor equilibrium; dermatitis; cardiac arrhythmias; liver damage	Eyes, skin, CNS, cardiovascular, liver	No A4 – ACGIH	90% of the waste is containerized. The remaining waste will be managed under appropriate work control documentation.
1,1,2,2-Tetrachloroethane	TWA: 5 ppm - skin	Ih, Ig, S, Con	Nausea; vomiting; abdominal pain; tremor fingers; jaundice, hepatitis, liver tenderness; dermatitis; monocytosis; kidney damage	Skin, liver, kidneys, CNS, GI	Yes – NIOSH	90% of the waste is containerized. The remaining waste will be managed under appropriate work control documentation.
1,1,2-Trichloroethane	TWA: 10 ppm (45 mg/m^3) – skin	Ih, Ig, S, Con	Eye and nose irritation; CNS depressant; liver and kidney damage; dermatitis	Eyes, respiratory system, CNS, liver, kidneys	Yes – NIOSH	90% of the waste is containerized. The remaining waste will be managed under appropriate work control documentation.

Table 2-3. (continued)

Material or Chemical (CAS #, Vapor Density & Ionization Energy)[a]	Exposure Limit[b] (PEL/TLV)	Routes of Exposure[c]	Indicators or Symptoms of Over-Exposure[d] (Acute and Chronic)	Target Organs/System	Carcinogen? (source)[e]	Exposure Potential (all routes without regard to PPE)
1,1-Dichloroethane	TWA: 100 ppm (400 mg/m^3)	Ih, Ig, Con	Skin irritation; CNS depressant; liver, kidney and lung damage	Skin, liver, kidneys, lungs, CNS	No	90% of the waste is containerized. The remaining waste will be managed under appropriate work control documentation.
1,1-Dichloroethene	TLV not established	Ih, Ig, S, Con	Eye, skin, and throat irritation; dizziness; headache; nausea; dyspnea; liver, kidney dysfunction; pneumonitis	Eyes, skin, respiratory system, CNS, liver, kidneys	Yes – NIOSH	90% of the waste is containerized. The remaining waste will be managed under appropriate work control documentation.
1,2,4-Trichlorobenzene	NIOSH REL: 5 ppm (40 mg/m^3) ACGIH Ceiling 5 ppm	Ih, Ig, S, Con	Eye, skin, and mucous membrane irritation; liver and kidney damage; possible teratogenic effects	Eyes, skin, respiratory system, liver, reproductive system	No	90% of the waste is containerized. The remaining waste will be managed under appropriate work control documentation.
1,2-Dichlorobenzene	PEL: 50 ppm (300 mg/m^3)	Ih, Ig, S, Con	Eye and nose irritation; liver and kidney damage; skin blisters	Eyes, skin, respiratory system, liver, kidneys	No	90% of the waste is containerized. The remaining waste will be managed under appropriate work control documentation.
1,2-Dichloroethane	TWA: 50 ppm	Ih, Ig, S, Con	Eye irritation; corneal opacity; CNS depressant; nausea; vomiting; dermatitis; liver, kidney and CNS damage	Eyes, skin, kidneys, liver, CNS, cardiovascular system	Yes – NIOSH	90% of the waste is containerized. The remaining waste will be managed under appropriate work control documentation.

Table 2-3. (continued)

Material or Chemical (CAS #, Vapor Density & Ionization Energy)[a]	Exposure Limit[b] (PEL/TLV)	Routes of Exposure[c]	Indicators or Symptoms of Over-Exposure[d] (Acute and Chronic)	Target Organs/System	Carcinogen? (source)[e]	Exposure Potential (all routes without regard to PPE)
1,2-Dichloroethene (total)	TWA: 200 ppm (790 mg/m^3)	Ih, Ig, Con	Eye and respiratory system irritation; CNS depressant	Eyes, respiratory system, CNS	No	90% of the waste is containerized. The remaining waste will be managed under appropriate work control documentation.
1,3-Dichlorobenzene	TLV not established	Ih, Ig, S, Con	Eye, skin, respiratory tract irritation; GI irritation with nausea, vomiting and diarrhea; liver and kidney damage	Eyes, respiratory system, skin, GI, liver, kidneys	No	90% of the waste is containerized. The remaining waste will be managed under appropriate work control documentation.
1,4-Dichlorobenzene	TWA: 75 ppm (450 mg/m^3)	Ih, Ig, S, Con	Eye irritation; swelling periorbital; profuse rhinitis; headache, anorexia, nausea, vomiting; weight loss, jaundice, cirrhosis; liver, kidney injury	Liver, respiratory system, eyes, kidneys, skin	Yes – NIOSH	90% of the waste is containerized. The remaining waste will be managed under appropriate work control documentation.
1,4-Dioxane	TWA: 100 ppm (360 mg/m^3) – skin	Ih, Ig, S, Con	Eye, skin, nose, and throat irritation; drowsiness; headache; nausea; vomiting; liver damage; kidney failure	Eyes, skin, respiratory system, liver, kidneys	Yes – NIOSH	90% of the waste is containerized. The remaining waste will be managed under appropriate work control documentation.
2-Butanone	TWA: 200 ppm (590 mg/m^3)	Ih, Ig, Con	Eye, skin and nose irritation; headache; dizziness; vomiting; dermatitis	Eyes, skin, respiratory system, CNS	No	90% of the waste is containerized. The remaining waste will be managed under appropriate work control documentation.

Table 2-3. (continued)

Material or Chemical (CAS #, Vapor Density & Ionization Energy)[a]	Exposure Limit[b] (PEL/TLV)	Routes of Exposure[c]	Indicators or Symptoms of Over-Exposure[d] (Acute and Chronic)	Target Organs/System	Carcinogen? (source)[e]	Exposure Potential (all routes without regard to PPE)
2-Chloronaphthalene	TLV not established	Ih, Ig, S, Con	Eye, skin, respiratory tract, and digestive tract irritation	Eyes, skin, respiratory tract, GI	No	90% of the waste is containerized. The remaining waste will be managed under appropriate work control documentation.
2-Chlorophenol	TLV not established	Ih, Ig, S, Con	Eye, skin, and respiratory tract irritation	Eyes, skin, respiratory tract	No	90% of the waste is containerized. The remaining waste will be managed under appropriate work control documentation.
2-Hexanone	TWA: 100 ppm (410 mg/m^3)	Ih, Ig, S, Con	Eye and nose irritation; peripheral neuropathy: weakness, paresthesia; dermatitis; headache, drowsiness	Eyes, skin, respiratory system, CNS, peripheral nervous system	No	90% of the waste is containerized. The remaining waste will be managed under appropriate work control documentation.
2-Methylnaphthalene	TLV not established	Ih, Ig, S, Con	Eye, skin, digestive tract, and respiratory tract irritation	Eyes, skin, respiratory tract, GI	No	90% of the waste is containerized. The remaining waste will be managed under appropriate work control documentation.

Table 2-3. (continued)

Material or Chemical (CAS #, Vapor Density & Ionization Energy)[a]	Exposure Limit[b] (PEL/TLV)	Routes of Exposure[c]	Indicators or Symptoms of Over-Exposure[d] (Acute and Chronic)	Target Organs/System	Carcinogen? (source)[e]	Exposure Potential (all routes without regard to PPE)
2-Methylphenol	TWA: 5 ppm (22 mg/m^3) – skin	Ih, Ig, S, Con	Eye, skin, and mucous membrane irritation; CNS effects; confusion; depression; respiratory failure; dyspnea; irregular/rapid respiratory; weak pulse; eye and skin burns; dermatitis; lung, liver, kidney and pancreas damage	Eyes, skin, respiratory system, CNS, liver, kidneys, pancreas, cardiovascular system	No	90% of the waste is containerized. The remaining waste will be managed under appropriate work control documentation.
2-Nitroaniline	TLV not established.	Ih, S, Con	The substance may cause effects on the blood: methemoglobinemia, resulting in cyanosis and kidney impairment. The effects may be delayed.	Cardiovascular system, kidneys	No	90% of the waste is containerized. The remaining waste will be managed under appropriate work control documentation.
2-Nitrophenol	TLV not established	Ih, Ig, S, Con	Respiratory tract irritation; coughing, shortness of breath; formation of methemoglobin, resulting in cyanosis, headaches, dizziness and collapse; breathing trouble, a slow pulse, fall in blood pressure, convulsions; skin and eye irritation; liver and kidney damage	Eyes, skin, respiratory tract, liver, kidneys	No	90% of the waste is containerized. The remaining waste will be managed under appropriate work control documentation.

Table 2-3. (continued)

Material or Chemical (CAS #, Vapor Density & Ionization Energy)[a]	Exposure Limit[b] (PEL/TLV)	Routes of Exposure[c]	Indicators or Symptoms of Over-Exposure[d] (Acute and Chronic)	Target Organs/System	Carcinogen? (source)[e]	Exposure Potential (all routes without regard to PPE)
2,4,5-Trichlorophenol	TLV not established	Ih, Ig, S, Con	Eye and skin irritation; cough; sore throat; blurred vision; abdominal pain; diarrhea; dizziness; headache; vomiting; weakness; fatigue; sweating	Skin, eyes, respiratory system, liver, kidneys, GI	No	90% of the waste is containerized. The remaining waste will be managed under appropriate work control documentation.
2,4,6-Trichlorophenol	TLV not established	Ih, Ig, S, Con	Eye and skin irritation; cough; diarrhea; nausea; vomiting; weakness	Eyes, skin, respiratory tract, liver	Yes – NIOSH	90% of the waste is containerized. The remaining waste will be managed under appropriate work control documentation.
2,4-Dichlorophenol	TLV not established	Ih, Ig, S, Con	Eye, skin, and respiratory tract irritation and burning; cough; shortness of breath; blisters in throat and severe deep burns on skin; abdominal cramps	Eyes, skin, respiratory tract, GI	No	90% of the waste is containerized. The remaining waste will be managed under appropriate work control documentation.
2,4-Dimethylphenol (Xylenol)	TLV not established	Ih, Ig, S, Con	Eye, skin, respiratory tract, and digestive tract irritation; acute ingestion; kidney damage	Eyes, skin, respiratory tract, GI, kidneys	No	90% of the waste is containerized. The remaining waste will be managed under appropriate work control documentation.
2,4-Dinitrophenol	TLV not established	Ih, Ig, S, Con	Redness, roughness, and yellowing of the skin; nausea; vomiting; palpitations; collapse; sweating	Skin, eyes, peripheral nervous system, GI	No	90% of the waste is containerized. The remaining waste will be managed under appropriate work control documentation.

Table 2-3. (continued)

Material or Chemical (CAS #, Vapor Density & Ionization Energy)[a]	Exposure Limit[b] (PEL/TLV)	Routes of Exposure[c]	Indicators or Symptoms of Over-Exposure[d] (Acute and Chronic)	Target Organs/System	Carcinogen? (source)[e]	Exposure Potential (all routes without regard to PPE)
2,4-Dinitrotoluene	TLV: 0.2 mg/m^3 – skin	Ih, Ig, S, Con	Anoxia; headache; dizziness; nausea; confusion; convulsions; cyanosis; anemia; jaundice; reproductive effects	Eyes, skin, blood, liver, cardiovascular system, CNS, reproductive system	Yes – NIOSH	90% of the waste is containerized. The remaining waste will be managed under appropriate work control documentation.
2,6-Dinitrotoluene	TLV: 0.2 mg/m^3 – skin	Ih, Ig, S, Con	Anoxia; headache; dizziness; nausea; confusion; convulsions; cyanosis; anemia; jaundice; reproductive effects	Eyes, skin, blood, liver, cardiovascular system, CNS, reproductive system	Yes – NIOSH	90% of the waste is containerized. The remaining waste will be managed under appropriate work control documentation.
3-Methyl Butanal (3-methylbutyraldehyde)	TLV not established	Ih, Ig, S, Con	Eye, skin, and respiratory tract irritation; nausea, vomiting; diarrhea; dizziness	Eye, skin, respiratory tract, GI	No	90% of the waste is containerized. The remaining waste will be managed under appropriate work control documentation.
3-Nitroaniline	TLV not established	Ih, S, Con	The substance may cause effects on the blood: methemoglobinemia, resulting in cyanosis and kidney impairment	Blood, kidneys	No	90% of the waste is containerized. The remaining waste will be managed under appropriate work control documentation.
3,3'-Dichlorobenzidine	PEL not established, but regulated under 29 CFR 1910.1007	Ih, Ig, S, Con	Skin sensitization; dermatitis; headache; dizziness; caustic burns; frequent urination; dysuria; hematuria; gastrointestinal upset; upper respiratory infection	Bladder, liver, lung, skin, GI	Yes – NIOSH	90% of the waste is containerized. The remaining waste will be managed under appropriate work control documentation.

Table 2-3. (continued)

Material or Chemical (CAS #, Vapor Density & Ionization Energy)[a]	Exposure Limit[b] (PEL/TLV)	Routes of Exposure[c]	Indicators or Symptoms of Over-Exposure[d] (Acute and Chronic)	Target Organs/System	Carcinogen? (source)[e]	Exposure Potential (all routes without regard to PPE)
4-Bromophenyl-phenylether	TLV not established	No information available	No information available	No information available	No information available	90% of the waste is containerized. The remaining waste will be managed under appropriate work control documentation.
4-Chloro-3-methylphenol	TLV not established	Ih, Ig, S, Con	Eye, skin, GI, and respiratory tract irritation; dermatitis; nausea, vomiting, diarrhea; liver and kidney damage	Eyes, skin, GI, respiratory tract, liver, kidneys	No	90% of the waste is containerized. The remaining waste will be managed under appropriate work control documentation.
4-Chloroaniline	TLV not established	Ih, Ig, S, Con	Eye, skin, and respiratory tract irritation. The substance may cause effects on the red blood cells, resulting in formation of methaemoglobin and hemolysis; lowering of consciousness; skin sensitization. The substance may have effects on the spleen, liver and kidneys, resulting in organ damage	Eyes, skin, respiratory tract, blood, spleen, liver, kidneys	Yes – NIOSH	90% of the waste is containerized. The remaining waste will be managed under appropriate work control documentation.
4-Chlorophenyl-phenylether (4-chloro-diphenyl Ether)	TLV not established	Ih, Ig, S, Con	Eye, skin, respiratory tract, and digestive tract irritation	Eye, skin, respiratory tract, GI	No	90% of the waste is containerized. The remaining waste will be managed under appropriate work control documentation.

Table 2-3. (continued)

Material or Chemical (CAS #, Vapor Density & Ionization Energy)[a]	Exposure Limit[b] (PEL/TLV)	Routes of Exposure[c]	Indicators or Symptoms of Over-Exposure[d] (Acute and Chronic)	Target Organs/System	Carcinogen? (source)[e]	Exposure Potential (all routes without regard to PPE)
4-Methyl-2-Pentanone	TWA: 100 ppm (410 mg/m^3)	Ih, Ig, Con	Eye, skin, and mucous membrane irritation; headache; narcosis; coma; dermatitis; liver and kidney damage	Eyes, skin, respiratory system, CNS, liver, kidneys	No	90% of the waste is containerized. The remaining waste will be managed under appropriate work control documentation.
4-Methylphenol	TWA: 5 ppm (22 mg/m^3) – skin	Ih, Ig, S, Con	Eye, skin, and mucous membrane irritation; CNS effects; confusion; depression; respiratory failure; dyspnea; irregular/rapid respiration; weak pulse; eye and skin burns; dermatitis; lung, liver, kidney, and pancreas damage	Eyes, skin, respiratory system, CNS, liver, kidneys, pancreas, cardiovascular system	No	90% of the waste is containerized. The remaining waste will be managed under appropriate work control documentation.
4-Nitroaniline	TLV: (3 mg/m^3) – skin	Ih, Ig, S, Con	Nose and throat irritation; cyanosis; ataxia; tachycardia; tachypnea; dyspnea; irritability; vomiting; diarrhea; convulsions; respiratory arrest; anemia; jaundice	Respiratory system, blood, heart, liver	No	90% of the waste is containerized. The remaining waste will be managed under appropriate work control documentation.
4-Nitrophenol (PNP)	TLV not established	Ih, S, Con	Inhalation of high levels may cause metabolism increase; cough; dizziness; weakness; skin irritation	Skin, respiratory tract	No	90% of the waste is containerized. The remaining waste will be managed under appropriate work control documentation.

Table 2-3. (continued)

Material or Chemical (CAS #, Vapor Density & Ionization Energy)[a]	Exposure Limit[b] (PEL/TLV)	Routes of Exposure[c]	Indicators or Symptoms of Over-Exposure[d] (Acute and Chronic)	Target Organs/System	Carcinogen? (source)[e]	Exposure Potential (all routes without regard to PPE)
4,6-Dinitro-2-methylphenol	TWA: 0.2 mg/m^3 – skin	Ih, Ig, S, Con	Sense of well being; headache; fever; lassitude; profuse sweating; excess thirst; tachycardia; hyperpnea; cough; shortness of breath; coma	Cardiovascular system, endocrine system	No	90% of the waste is containerized. The remaining waste will be managed under appropriate work control documentation.
Acenaphthene (ethylene naphthalene)	TLV not established	Ih, Ig, S, Con	Eye, skin, respiratory tract, and digestive tract irritation	Eye, skin, respiratory tract, GI	No	90% of the waste is containerized. The remaining waste will be managed under appropriate work control documentation.
Acenaphthylene	TLV not established	Ih, Ig, S, Con	Eye, skin, respiratory tract, and digestive tract irritation	Eye, skin, respiratory tract, GI	No	90% of the waste is containerized. The remaining waste will be managed under appropriate work control documentation.
Acetone	TWA: 1000 ppm (2400 mg/m^3)	Ih, Ig, Con	Eye, nose and throat irritation; headache; dizziness; CNS depression; dermatitis	Eyes, skin, respiratory system, CNS	No	90% of the waste is containerized. The remaining waste will be managed under appropriate work control documentation.
Acetonitrile	TWA: 40 ppm (70 mg/m^3)	Ih, Ig, S, Con	Nose and throat irritation; asphyxia; nausea; vomiting; chest pain; weakness; stupor; convulsions; liver and kidney damage	Respiratory system, cardiovascular system, CNS, liver, kidneys	No	90% of the waste is containerized. The remaining waste will be managed under appropriate work control documentation.

Table 2-3. (continued)

Material or Chemical (CAS #, Vapor Density & Ionization Energy)[a]	Exposure Limit[b] (PEL/TLV)	Routes of Exposure[c]	Indicators or Symptoms of Over-Exposure[d] (Acute and Chronic)	Target Organs/System	Carcinogen? (source)[e]	Exposure Potential (all routes without regard to PPE)
Acrolein	TWA: 0.1 ppm (0.25 mg/m^3)	Ih, Ig, Con	Eyes, skin and mucous membrane; decreased pulmonary function; delayed pulmonary edema; chronic respiratory disease	Eyes, skin, respiratory system, heart	No	90% of the waste is containerized. The remaining waste will be managed under appropriate work control documentation.
Acrylonitrile	TWA: 2 ppm	Ih, Ig, S, Con	Eye and skin irritation; asphyxia; headache; sneezing; nausea; vomiting; weakness; lightheadedness; skin vesiculation; scaling dermatitis	Eyes, skin, cardiovascular system, liver, kidneys, CNS	Yes – NIOSH	90% of the waste is containerized. The remaining waste will be managed under appropriate work control documentation.
Anthracene	TLV not established	Ih, Ig, S, Con	Cough; labored breathing; sore throat; abdominal pain; skin and eye irritation	Eyes, skin, respiratory tract, gastrointestinal tract	No	90% of the waste is containerized. The remaining waste will be managed under appropriate work control documentation.
Aramite	TLV not established	No information available	No information available	No information available	No information available	90% of the waste is containerized. The remaining waste will be managed under appropriate work control documentation.
Aroclor-1016	TLV not established	Ih, Ig, S, Con	GI disturbances; eye injury; liver damage, kidney damage, cardiovascular system injury, convulsions	Kidney, cardiovascular system, liver	No	90% of the waste is containerized. The remaining waste will be managed under appropriate work control documentation.

Table 2-3. (continued)

Material or Chemical (CAS #, Vapor Density & Ionization Energy)[a]	Exposure Limit[b] (PEL/TLV)	Routes of Exposure[c]	Indicators or Symptoms of Over-Exposure[d] (Acute and Chronic)	Target Organs/System	Carcinogen? (source)[e]	Exposure Potential (all routes without regard to PPE)
Aroclor-1254	TWA: 0.5 mg/m^3 – skin	Ih, Ig, S, Con	Eye irritation; chloracne; liver damage; reproductive effects	Skin, eyes, liver, reproductive system	Yes – NIOSH	90% of the waste is containerized. The remaining waste will be managed under appropriate work control documentation.
Aroclor-1260	TLV not established	Ih, S, Con	Eye irritation, eye inflammation, and swelling of adjoining tissues; GI disturbances; discoloration of the nail and skin; cancer hazard; liver damage; delayed adverse health effects; chloracne	Eyes, GI, skin, liver	Yes – NIOSH	90% of the waste is containerized. The remaining waste will be managed under appropriate work control documentation.
Aroclor-1268	TLV not established	Ih, Ig, S, Con	Chloracne; GI disturbances; eye irritation, inflammation and swelling if the adjoining tissues; discoloration of the nails and skin; liver injury; delayed health effects	Eyes, skin, GI, liver	No	90% of the waste is containerized. The remaining waste will be managed under appropriate work control documentation.
Benzene	TWA: 1 ppm (29 CFR 1910.1028) TLV: 0.5 ppm	Ih, Ig, S, Con	Eye, skin, nose and respiratory system irritation; giddiness; headache; nausea; staggered gait; fatigue; anorexia; weakness; exhaustion; dermatitis; bone marrow depression	Eyes, skin, respiratory system, blood, CNS, bone marrow	Yes – NIOSH	90% of the waste is containerized. The remaining waste will be managed under appropriate work control documentation.

Table 2-3. (continued)

Material or Chemical (CAS #, Vapor Density & Ionization Energy)[a]	Exposure Limit[b] (PEL/TLV)	Routes of Exposure[c]	Indicators or Symptoms of Over-Exposure[d] (Acute and Chronic)	Target Organs/System	Carcinogen? (source)[e]	Exposure Potential (all routes without regard to PPE)
Benzidine	No established PEL, but regulated under 29 CFR 1910.1010	Ih, Ig, S, Con	Hematuria; secondary anemia from hemolysis; acute cystitis; acute liver disorders; dermatitis; painful, irregular urination	Bladder, skin, kidneys, liver, blood	Yes – NIOSH	90% of the waste is containerized. The remaining waste will be managed under appropriate work control documentation.
Benz(a)anthracene	Exposures by all routes should be controlled to levels as low as possible	Ih, Ig, S, Con	Substance probably carcinogenic to humans	No information available	Yes – NIOSH	90% of the waste is containerized. The remaining waste will be managed under appropriate work control documentation.
Benzo(a)pyrene	Exposures by all routes should be controlled to levels as low as possible	Ih, Ig, S, Con	Eye, skin, respiratory tract, and digestive tract irritation	Eye, skin, respiratory tract, GI	Yes – NIOSH	90% of the waste is containerized. The remaining waste will be managed under appropriate work control documentation.
Benzo (b) fluoranthene	TLV not established	Ih, S, Con	Substance possibly carcinogenic to humans	No information available	Yes – NIOSH	90% of the waste is containerized. The remaining waste will be managed under appropriate work control documentation.
Benzo (g,h,i) perylene	TLV not established	Ih, S, Con	No information available	No information available	No	90% of the waste is containerized. The remaining waste will be managed under appropriate work control documentation.

Table 2-3. (continued)

Material or Chemical (CAS #, Vapor Density & Ionization Energy)[a]	Exposure Limit[b] (PEL/TLV)	Routes of Exposure[c]	Indicators or Symptoms of Over-Exposure[d] (Acute and Chronic)	Target Organs/System	Carcinogen? (source)[e]	Exposure Potential (all routes without regard to PPE)
Benzo (k) fluoranthene	TLV not established	Ih, S, Con	Substance possibly carcinogenic to humans	No information available	Yes – NIOSH	90% of the waste is containerized. The remaining waste will be managed under appropriate work control documentation.
Benzoic acid	TLV not established	Ih, Ig	The substance irritates the eyes, the skin and the respiratory tract; skin sensitization; abdominal pain	Skin, eyes, respiratory tract	No	90% of the waste is containerized. The remaining waste will be managed under appropriate work control documentation.
bis (2-Chloroethoxy) methane	TLV not established	No information available	No information available	No information available	No information available	90% of the waste is containerized. The remaining waste will be managed under appropriate work control documentation.
bis (2-Chloroethyl) ether	TWA: 15 ppm (90 mg/m^3)	Ih, Ig, S, Con	Nose, throat and respiratory system irritation; lacrimation; cough; nausea; vomiting; pulmonary edema; liver damage	Eyes, respiratory system, liver	Yes – NIOSH	
bis (2-Chloroisopropyl) ether	TLV not established	No information available	No information available	No information available	No information available	90% of the waste is containerized. The remaining waste will be managed under appropriate work control documentation.

Table 2-3. (continued)

Material or Chemical (CAS #, Vapor Density & Ionization Energy)[a]	Exposure Limit[b] (PEL/TLV)	Routes of Exposure[c]	Indicators or Symptoms of Over-Exposure[d] (Acute and Chronic)	Target Organs/System	Carcinogen? (source)[e]	Exposure Potential (all routes without regard to PPE)
bis (2-Ethylhexyl) phthalate	TWA: 5 mg/m^3	Ih, Ig, Con	Eye and mucous membrane irritation; liver damage; teratogenic effects	Eyes, respiratory system, CNS, liver, reproductive system, GI	Yes – NIOSH	90% of the waste is containerized. The remaining waste will be managed under appropriate work control documentation.
Butane,1,1,3,4-Tetrachloro-	TLV not established	No information available	No information available	No information available	No information available	90% of the waste is containerized. The remaining waste will be managed under appropriate work control documentation.
Butylbenzylphthalate	TLV not established	No information available	No information available	No information available	No information available	90% of the waste is containerized. The remaining waste will be managed under appropriate work control documentation.
Carbazole	TLV not established	Ih, Ig, S, Con	Eye, skin, respiratory tract, and digestive tract irritation; Substance may cause cancer	Eye, skin, respiratory tract, GI	Yes – NIOSH	90% of the waste is containerized. The remaining waste will be managed under appropriate work control documentation.

Table 2-3. (continued)

Material or Chemical (CAS #, Vapor Density & Ionization Energy)[a]	Exposure Limit[b] (PEL/TLV)	Routes of Exposure[c]	Indicators or Symptoms of Over-Exposure[d] (Acute and Chronic)	Target Organs/System	Carcinogen? (source)[e]	Exposure Potential (all routes without regard to PPE)
Carbon Disulfide	TWA: 20 ppm	Ih, Ig, S, Con	Dizziness; headache; poor sleep; fatigue; nervousness; anorexia; weight loss; phychosis; polyneuropathy; Parkinson-like syndrome; ocular changes; coronary heart disease; gastritis; kidney and liver injury; eye and skin burns; dermatitis; reproductive effects	CNS, peripheral nervous system, cardiovascular system, eyes, kidneys, liver, skin, reproductive system	No	90% of the waste is containerized. The remaining waste will be managed under appropriate work control documentation.
Chlorobenzene	TWA: 75 ppm (350 mg/m^3)	Ih, Ig, Con	Eye, skin, and nose irritation; drowsiness, incoordination; CNS depression; liver, lung, and kidney injury	Eyes, skin, respiratory system, CNS, liver	No	90% of the waste is containerized. The remaining waste will be managed under appropriate work control documentation.
Chloroethane	TWA: 1000 ppm (2600 mg/m^3)	Ih, Ig, S, Con	Incoordination; inebriation; abdominal cramps; cardiac arrhythmias, cardiac arrest; liver and kidney damage	Liver, kidneys, respiratory system, cardiovascular system, CNS	No	90% of the waste is containerized. The remaining waste will be managed under appropriate work control documentation.
Chloromethane	TWA: 100 ppm	Ih, Con	Dizziness, nausea, vomiting; visual disturbance, stagger, slurred speech, convulsions, coma; liver, kidney damage; liquid: frostbite; reproductive, teratogenic effects	CNS, liver, kidneys, reproductive system	Yes – NIOSH	90% of the waste is containerized. The remaining waste will be managed under appropriate work control documentation.

Table 2-3. (continued)

Material or Chemical (CAS #, Vapor Density & Ionization Energy)[a]	Exposure Limit[b] (PEL/TLV)	Routes of Exposure[c]	Indicators or Symptoms of Over-Exposure[d] (Acute and Chronic)	Target Organs/System	Carcinogen? (source)[e]	Exposure Potential (all routes without regard to PPE)
Chrysene (coal tar pitch volatiles)	TWA: 0.2 mg/m^3	Ih, Con	Dermatitis; bronchitis	Respiratory system, skin, bladder, kidneys	Yes – NIOSH	90% of the waste is containerized. The remaining waste will be managed under appropriate work control documentation.
Decane, 3,4-Dimethyl	TLV not established	No information available	No information available	No information available	No information available	90% of the waste is containerized. The remaining waste will be managed under appropriate work control documentation.
Diacetone alcohol	TWA: 50 ppm (240 mg/m^3)	Ih, Ig, Con	Irritation eyes, skin, nose, throat; corneal damage; narcosis, liver damage	Eyes, skin, respiratory system, CNS, liver	No	90% of the waste is containerized. The remaining waste will be managed under appropriate work control documentation.
Dibenz(a,h)anthracene	TLV not established	Ih, Ig, S, Con	The substance may have effects on the skin, resulting in photosensitization. This substance is probably carcinogenic to humans.	Skin	Yes – NIOSH	90% of the waste is containerized. The remaining waste will be managed under appropriate work control documentation.
Dibenzofuran	TLV not established	Ih, Ig, S, Con	Eye, skin, respiratory tract, and GI irritation; nausea; vomiting; diarrhea	Eye, skin, respiratory tract, GI	No	90% of the waste is containerized. The remaining waste will be managed under appropriate work control documentation.

Table 2-3. (continued)

Material or Chemical (CAS #, Vapor Density & Ionization Energy)[a]	Exposure Limit[b] (PEL/TLV)	Routes of Exposure[c]	Indicators or Symptoms of Over-Exposure[d] (Acute and Chronic)	Target Organs/System	Carcinogen? (source)[e]	Exposure Potential (all routes without regard to PPE)
Diethylphthalate	TWA: 5 mg/m^3	Ih, Ig, Con	Eye, skin, nose, and throat irritation; headache, dizziness, nausea; lacrimation; polyneuropathy, vestibular dysfunction; pain, numbness, weakness, spasms in arms and legs; reproductive effects	Eyes, skin, respiratory system, CNS, peripheral nervous system, reproductive system	No	90% of the waste is containerized. The remaining waste will be managed under appropriate work control documentation.
Dimethyl Disulfide (methyl disulfide)	TLV not established	Ih, Ig, S, Con	Eye, skin, respiratory tract, and GI irritation; nausea; vomiting; diarrhea; dizziness; suffocation; blood abnormalities; liver damage; irritation of the mucous membrane; lacrimation, cyanosis, central nervous system depression or hemorrhage in the lung; hemolytic anemia; renal failure	Eye, skin, respiratory tract, GI, blood, liver, kidneys, CNS	No	90% of the waste is containerized. The remaining waste will be managed under appropriate work control documentation.
Dimethylphthalate	TWA: 5 mg/m^3	Ih, Ig, Con	Eye and upper respiratory irritation; stomach pain	Eyes, respiratory system, GI	No	90% of the waste is containerized. The remaining waste will be managed under appropriate work control documentation.
Di-n-butylphthalate	TWA: 5 mg/m^3	Ih, Ig, Con	Eye and upper respiratory irritation; stomach	Eyes, respiratory system, GI	No	90% of the waste is containerized. The remaining waste will be managed under appropriate work control documentation.

Table 2-3. (continued)

Material or Chemical (CAS #, Vapor Density & Ionization Energy)[a]	Exposure Limit[b] (PEL/TLV)	Routes of Exposure[c]	Indicators or Symptoms of Over-Exposure[d] (Acute and Chronic)	Target Organs/System	Carcinogen? (source)[e]	Exposure Potential (all routes without regard to PPE)
Di-n-octylphthalate	TWA: 5 mg/m^3	Ih, Ig, Con	Eye and mucous membrane irritation, liver damage, teratogenic effects	Eyes, respiratory system, CNS, liver, reproductive system, GI	Yes – NIOSH	90% of the waste is containerized. The remaining waste will be managed under appropriate work control documentation.
Eicosane	TLV not established	Ih, Ig, S, Con	Eye, skin, digestive, and respiratory system irritation	Eyes, skin, GI, respiratory system	No	90% of the waste is containerized. The remaining waste will be managed under appropriate work control documentation.
Ethyl cyanide	TWA: 6 ppm (14 mg/m^3)	Ih, Ig, S, Con	Eye, skin, and respiratory system irritation; nausea, vomiting; chest pain; weakness; stupor; convulsions; liver and kidney damage	Eyes, skin, respiratory system, cardiovascular system, CNS, liver, kidneys	No	90% of the waste is containerized. The remaining waste will be managed under appropriate work control documentation.
Ethylbenzene	TWA: 100 ppm (435 mg/m^3)	Ih, Ig, Con	Eye, skin, and mucous membrane irritation; headache; dermatitis; narcosis, coma	Eyes, skin, respiratory system, CNS	No	90% of the waste is containerized. The remaining waste will be managed under appropriate work control documentation.
Famphur	TLV: 0.2 mg/m^3	Ih, Ig, S, Con	Weakness, headache, tightness of chest, blurred vision, nonreactive pinpoint pupils, salivation, sweating, nausea, vomiting, diarrhea, and abdominal cramps	GI	No	90% of the waste is containerized. The remaining waste will be managed under appropriate work control documentation.

Table 2-3. (continued)

Material or Chemical (CAS #, Vapor Density & Ionization Energy)[a]	Exposure Limit[b] (PEL/TLV)	Routes of Exposure[c]	Indicators or Symptoms of Over-Exposure[d] (Acute and Chronic)	Target Organs/System	Carcinogen? (source)[e]	Exposure Potential (all routes without regard to PPE)
Fluoranthene	TLV not established	Ih, Ig, S, Con	Eye and skin irritation; skin burns; rapid heartbeat; GI irritation; cardiac arrhythmias; pulmonary edema; defatting and dermatitis	Eyes, skin, cardiovascular system, GI	Yes – NIOSH	90% of the waste is containerized. The remaining waste will be managed under appropriate work control documentation.
Fluorene	TLV not established	Ih, Ig, S, Con	Eye, skin, respiratory, and GI irritation; nausea; vomiting; diarrhea	Eyes, skin, GI, respiratory system	Yes – NIOSH	90% of the waste is containerized. The remaining waste will be managed under appropriate work control documentation.
Heptadecane, 2,6,10,15-Tetra	TLV not established	No information available	No information available	No information available	No information available	90% of the waste is containerized. The remaining waste will be managed under appropriate work control documentation.
Hexachlorobenzene	TLV not established	Ih, Ig, S, Con	Lungs may be affected by repeated or prolonged exposure. The substance may have effects on the liver, skin, and nervous system. This substance is possibly carcinogenic to humans. Animal tests show that this substance possibly causes toxic effects upon human reproduction	Lungs, liver, skin, nervous system,	No information available	90% of the waste is containerized. The remaining waste will be managed under appropriate work control documentation.

Table 2-3. (continued)

Material or Chemical (CAS #, Vapor Density & Ionization Energy)[a]	Exposure Limit[b] (PEL/TLV)	Routes of Exposure[c]	Indicators or Symptoms of Over-Exposure[d] (Acute and Chronic)	Target Organs/System	Carcinogen? (source)[e]	Exposure Potential (all routes without regard to PPE)
Hexachlorobutadiene	TWA: 0.02 ppm (0.24 mg/m^3) – skin	Ih, Ig, S, Con	Eye, skin, and respiratory system irritation; kidney damage	Eyes, skin, respiratory system, kidneys	Yes – NIOSH	90% of the waste is containerized. The remaining waste will be managed under appropriate work control documentation.
Hexachlorocyclopentadiene	TWA: 0.01 ppm (0.1 mg/m^3)	Ih, Ig, S, Con	Eye, skin, and respiratory system irritation; eye and skin burns; lacrimation; sneezing; cough; dysspnea; salivation; pulmonary edema; nausea; vomiting; diarrhea; liver and kidney injury	Eyes, skin, respiratory system, liver, kidneys	No	90% of the waste is containerized. The remaining waste will be managed under appropriate work control documentation.
Hexachloroethane	TWA: 1 ppm (10 mg/m^3) – skin	Ih, Ig, S, Con	Eye, skin, and mucous membrane irritation; kidney damage	Eyes, skin, respiratory system, kidneys	Yes – NIOSH	90% of the waste is containerized. The remaining waste will be managed under appropriate work control documentation.
Indeno(1,2,3-cd)pyrene	TLV not established	No information available	No information available	No information available	No information available	90% of the waste is containerized. The remaining waste will be managed under appropriate work control documentation.
Isobutyl alcohol	TWA: 100 ppm (300 mg/m^3)	Ih, Ig, Con	Eye, skin, and throat irritation; headache; drowsiness; skin cracking; narcosis	Eyes, skin, respiratory system, CNS	No	90% of the waste is containerized. The remaining waste will be managed under appropriate work control documentation.

Table 2-3. (continued)

Material or Chemical (CAS #, Vapor Density & Ionization Energy)[a]	Exposure Limit[b] (PEL/TLV)	Routes of Exposure[c]	Indicators or Symptoms of Over-Exposure[d] (Acute and Chronic)	Target Organs/System	Carcinogen? (source)[e]	Exposure Potential (all routes without regard to PPE)
Isophorone	TWA: 25 ppm (140 mg/m^3)	Ih, Ig, Con	Eye, nose, and throat irritation; headache; nausea; dizziness; fatigue; malaise; narcosis; dermatitis; kidney and liver damage	Eyes, skin, respiratory system, CNS, liver, kidneys	No	90% of the waste is containerized. The remaining waste will be managed under appropriate work control documentation.
Isopropyl Alcohol/2-propanol	TWA: 400 ppm (980 mg/m^3)	Ih, Ig, Con	Eye, nose and throat irritation; drowsiness; dizziness; headache; dry cracking skin; narcosis	Eyes, skin, respiratory system	No	90% of the waste is containerized. The remaining waste will be managed under appropriate work control documentation.
Kepone	TWA: 0.001 mg/m^3	Ih, Ig, S, Con	Headache, nervousness, tremor; liver, kidney damage; visual disturbance; ataxia, chest pain, skin erythema; testicular atrophy, low sperm count	Eyes, skin, respiratory system, CNS, liver, kidneys, reproductive system	Yes – NIOSH	90% of the waste is containerized. The remaining waste will be managed under appropriate work control documentation.
Mesityl oxide	TWA: 25 ppm (100 mg/m^3)	Ih, Ig, Con	Eye, skin, and mucous membrane irritation; narcosis; coma; liver and kidney damage; CNS effects	Eyes, skin, respiratory system, CNS, liver kidneys	No	90% of the waste is containerized. The remaining waste will be managed under appropriate work control documentation.
Methyl Acetate	TWA: 200 ppm (610 mg/m^3)	Ih, Ig, Con	Eye, skin, nose and throat irritation; headache; drowsiness; optic nerve atrophy; chest tightness; narcosis	Eyes, skin, respiratory system, CNS	No	90% of the waste is containerized. The remaining waste will be managed under appropriate work control documentation.

Table 2-3. (continued)

Material or Chemical (CAS #, Vapor Density & Ionization Energy)[a]	Exposure Limit[b] (PEL/TLV)	Routes of Exposure[c]	Indicators or Symptoms of Over-Exposure[d] (Acute and Chronic)	Target Organs/System	Carcinogen? (source)[e]	Exposure Potential (all routes without regard to PPE)
Methylene Chloride	TWA: 25 ppm, and regulated by 29 CFR 1910.1052	Ih, Ig, S, Con	Eye and skin irritation; fatigue, weakness, somnolence, lightheadedness; numbness, tingle limbs; nausea	Eyes, skin, cardiovascular system, CNS	Yes – NIOSH	90% of the waste is containerized. The remaining waste will be managed under appropriate work control documentation.
Naphthalene	TWA: 10 ppm (50 mg/m^3)	Ih, Ig, S, Con	Eye irritation; headache, confusion, excitement, malaise; nausea, vomiting, abdominal pain; irritation bladder; profuse sweating; jaundice; hematuria, hemoglobinuria, renal shutdown; dermatitis, optical neuritis, corneal damage	Eyes, skin, blood, liver, kidneys, CNS	No	90% of the waste is containerized. The remaining waste will be managed under appropriate work control documentation.
Nitrobenzene	TWA: 1 ppm (5 mg/m^3) – skin	Ih, Ig, S, Con	Eye and skin irritation; anoxia; dermatitis; anemia; methemoglobinemia; liver and kidney damage; testicular effects	Eyes, skin, blood, liver, kidneys, cardiovascular system, reproductive system	No	90% of the waste is containerized. The remaining waste will be managed under appropriate work control documentation.
N-Nitroso-di-n-propylamine	TLV not established	No information available	No information available	No information available	No information available	90% of the waste is containerized. The remaining waste will be managed under appropriate work control documentation.

Table 2-3. (continued)

Material or Chemical (CAS #, Vapor Density & Ionization Energy)[a]	Exposure Limit[b] (PEL/TLV)	Routes of Exposure[c]	Indicators or Symptoms of Over-Exposure[d] (Acute and Chronic)	Target Organs/System	Carcinogen? (source)[e]	Exposure Potential (all routes without regard to PPE)
N-Nitrosodiphenylamine	TLV not established	Ih, Ig, S, Con	Carcinogen; mutagen; may cause cancers of the lungs, nasal sinuses, brain, esophagus, stomach, liver, bladder and kidneys	Lungs, thorax, respiratory system	Yes – NIOSH	90% of the waste is containerized. The remaining waste will be managed under appropriate work control documentation.
Octane,2,3,7-Trimethyl	TLV not established	No information available	No information available	No information available	No information available	90% of the waste is containerized. The remaining waste will be managed under appropriate work control documentation.
o-Toluenesulfonamide	TLV not established	No information available	No information available	No information available	No information available	90% of the waste is containerized. The remaining waste will be managed under appropriate work control documentation.
Pentachlorophenol	TWA: 0.5 mg/m^3 – skin	Ih, Ig, S, Con	Eye, nose and throat irritation; sneezing, cough; weakness, anorexia, weight loss; sweating; headache, dizziness; nausea, vomiting; dyspnea, chest pain; high fever; dermatitis	Eyes, skin, respiratory system, cardiovascular system, liver, kidneys, CNS	No	90% of the waste is containerized. The remaining waste will be managed under appropriate work control documentation.
Phenanthrene	TLV not established	Ih, Ig, S, Con	Eye, skin, digestive, and respiratory irritation	Eyes, skin, GI, respiratory system	Yes – NIOSH	90% of the waste is containerized. The remaining waste will be managed under appropriate work control documentation.

Table 2-3. (continued)

Material or Chemical (CAS #, Vapor Density & Ionization Energy)[a]	Exposure Limit[b] (PEL/TLV)	Routes of Exposure[c]	Indicators or Symptoms of Over-Exposure[d] (Acute and Chronic)	Target Organs/System	Carcinogen? (source)[e]	Exposure Potential (all routes without regard to PPE)
Phenol	TWA: 5 ppm (19 mg/m^3) – skin	Ih, Ig, S, Con	Eye, nose, and throat irritation; anorexia, weight loss; weakness, muscle ache, pain; dark urine; cyanosis; liver, kidney damage; skin burns; dermatitis; ochronosis; tremor, convulsions, twitching	Eyes, skin, respiratory system, liver, kidneys	No	90% of the waste is containerized. The remaining waste will be managed under appropriate work control documentation.
Phenol,2,6-Bis (1,1-Dimethyl)	TLV not established	No information available	No information available	No information available	No information available	90% of the waste is containerized. The remaining waste will be managed under appropriate work control documentation.
p-Toluenesulfonamide	TLV not established	Ih, Ig, S, Con	Eye, skin, digestive, and respiratory irritation; nausea, vomiting, diarrhea	Eyes, skin, GI, respiratory system	No	90% of the waste is containerized. The remaining waste will be managed under appropriate work control documentation.
Pyrene	TWA: 0.2 mg/m^3	Ih, Con	Dermatitis, bronchitis	Respiratory system, skin, bladder, kidneys	No	90% of the waste is containerized. The remaining waste will be managed under appropriate work control documentation.

Table 2-3. (continued)

Material or Chemical (CAS #, Vapor Density & Ionization Energy)[a]	Exposure Limit[b] (PEL/TLV)	Routes of Exposure[c]	Indicators or Symptoms of Over-Exposure[d] (Acute and Chronic)	Target Organs/System	Carcinogen? (source)[e]	Exposure Potential (all routes without regard to PPE)
Styrene	TWA: 100 ppm	Ih, Ig, S, Con	Eye, nose, and respiratory irritation; headache, fatigue, dizziness, confusion, malaise, drowsiness, weakness, unsteady gait; narcosis; defatting dermatitis; possible liver injury; reproductive effects	Eyes, skin, respiratory system, CNS, liver, reproductive system	No	90% of the waste is containerized. The remaining waste will be managed under appropriate work control documentation.
Tetrachloroethene	TWA: 100 ppm	Ih, Ig, S, Con	Eye, skin, nose, throat, and respiratory system irritation; nausea; flush face, neck; vertigo, dizziness, incoordination; headache, somnolence; skin erythema; liver damage	Eyes, skin, respiratory system, liver, kidneys, CNS	Yes – NIOSH	90% of the waste is containerized. The remaining waste will be managed under appropriate work control documentation.
Toluene	TWA: 200 ppm	Ih, Ig, S, Con	Eye and nose irritation; fatigue, weakness, confusion, euphoria, dizziness, headache; dilated pupils, lacrimation; nervousness, muscle fatigue, insomnia; paresthesia; dermatitis; liver, kidney damage	Eyes, skin, respiratory system, CNS, liver, kidneys	No	90% of the waste is containerized. The remaining waste will be managed under appropriate work control documentation.
Tributylphosphate	TWA: 5 mg/m^3	Ih, Ig, Con	Eye, skin, and respiratory system irritation; headache; nausea	Eyes, skin, respiratory system	No	90% of the waste is containerized. The remaining waste will be managed under appropriate work control documentation.

Table 2-3. (continued)

Material or Chemical (CAS #, Vapor Density & Ionization Energy)[a]	Exposure Limit[b] (PEL/TLV)	Routes of Exposure[c]	Indicators or Symptoms of Over-Exposure[d] (Acute and Chronic)	Target Organs/System	Carcinogen? (source)[e]	Exposure Potential (all routes without regard to PPE)
Trichloroethene	TWA: 100 ppm	Ih, Ig, S, Con	Eye and skin irritation; headache, vertigo; visual disturbance, fatigue, giddiness, tremor, somnolence, nausea, vomiting; dermatitis; cardiac arrhythmias, paresthesia; liver injury	Eyes, skin, respiratory system, heart, liver, kidneys, CNS	Yes – NIOSH	90% of the waste is containerized. The remaining waste will be managed under appropriate work control documentation.
Undecane,4,6-Dimethyl-	TLV not established	No information available	No information available	No information available	No information available	90% of the waste is containerized. The remaining waste will be managed under appropriate work control documentation.
Xylene (ortho)	TWA: 100 ppm (435 mg/m^3)	Ih, Ig, S, Con	Eye, skin, nose, and throat irritation; dizziness, excitement, drowsiness, incoordination, staggering gait; corneal vacuolization; anorexia, nausea, vomiting, abdominal pain; dermatitis	Eyes, skin, respiratory system, CNS, GI, blood, liver, kidneys	No	90% of the waste is containerized. The remaining waste will be managed under appropriate work control documentation.
Xylene (total)	TWA: 100 ppm (435 mg/m^3)	Ih, Ig, S, Con	Headache, loss of appetite, nervousness and pale skin; skin rash; eye damage; damage to bone marrow, causing low blood cell count; liver and kidney damage	Skin, eyes, blood, liver, kidneys	No	90% of the waste is containerized. The remaining waste will be managed under appropriate work control documentation.

Table 2-3. (continued)

Material or Chemical (CAS #, Vapor Density & Ionization Energy)[a]	Exposure Limit[b] (PEL/TLV)	Routes of Exposure[c]	Indicators or Symptoms of Over-Exposure[d] (Acute and Chronic)	Target Organs/System	Carcinogen? (source)[e]	Exposure Potential (all routes without regard to PPE)
Ytterbium	TLV not established	Ih, Ig, S, Con	Eye, skin, digestive, and respiratory irritation	Eyes, skin, GI, respiratory system	No	90% of the waste is containerized. The remaining waste will be managed under appropriate work control documentation.
INORGANIC COMPOUNDS						
Aluminum	TWA: 15 mg/m^3 (total); 5 mg/m^3 (resp)	Ih, Con	Eye, skin and respiratory system irritation	Eyes, skin, respiratory system	No	90% of the waste is containerized. The remaining waste will be managed under appropriate work control documentation.
Antimony	TWA: 0.5 mg/m^3	Ih, Ig, Con	Eye, skin, nose, throat, and mouth irritation; cough; dizziness; headache; nausea, vomiting, diarrhea; stomach cramps; insomnia; anorexia; unable to smell properly	Eyes, skin, respiratory system, cardiovascular system	No	90% of the waste is containerized. The remaining waste will be managed under appropriate work control documentation.
Arsenic	TWA: 0. mg/m^3, and regulated by 29 CFR 1910.1018	Ih, S, Con	Ulceration of nasal septum, dermatitis, gastrointestinal disturbances, peripheral neuropathy, respiratory irritation, hyperpigmentation of skin	Liver, kidneys, skin, lungs, lymphatic system	Yes – NIOSH	90% of the waste is containerized. The remaining waste will be managed under appropriate work control documentation.

Table 2-3. (continued)

Material or Chemical (CAS #, Vapor Density & Ionization Energy)[a]	Exposure Limit[b] (PEL/TLV)	Routes of Exposure[c]	Indicators or Symptoms of Over-Exposure[d] (Acute and Chronic)	Target Organs/System	Carcinogen? (source)[e]	Exposure Potential (all routes without regard to PPE)
Barium	TWA: 0.5 mg/m^3	Ih, Ig, Con	Eye, skin, and upper respiratory system irritation; skin burns; gastroenteritis; muscle spasm; slow pulse; extrasystoles; hypokalemia	Eyes, skin, respiratory system, heart, CNS	No	90% of the waste is containerized. The remaining waste will be managed under appropriate work control documentation.
Beryllium	TWA: 0.002 mg/m^3	Ih, Con	Berylliosis; anorexia, weight loss, weakness, chest pain, cough, clubbing of fingers, cyanosis, pulmonary insufficiency; irritation eyes; dermatitis	Eyes, skin, respiratory system	Yes – NIOSH	90% of the waste is containerized. The remaining waste will be managed under appropriate work control documentation.
Boron	TLV not established	Ih, Con	Eye, skin and respiratory system irritation. Low hazard.	Eyes, skin, respiratory system	No	90% of the waste is containerized. The remaining waste will be managed under appropriate work control documentation.
Cadmium	TWA: 0.005 mg/m^3, and is regulated by 29 CFR 1910.1027	Ih, Ig	Pulmonary edema, dyspnea, cough, chest tightness, substernal pain; headache; chills, muscle aches; nausea, vomiting, diarrhea; anosmia , emphysema, proteinuria, mild anemia	Respiratory system, kidneys, prostate, blood	Yes – NIOSH	90% of the waste is containerized. The remaining waste will be managed under appropriate work control documentation.
Calcium	TLV not established	Con	Eye irritation	Eyes	No	90% of the waste is containerized. The remaining waste will be managed under appropriate work control documentation.

Table 2-3. (continued)

Material or Chemical (CAS #, Vapor Density & Ionization Energy)[a]	Exposure Limit[b] (PEL/TLV)	Routes of Exposure[c]	Indicators or Symptoms of Over-Exposure[d] (Acute and Chronic)	Target Organs/System	Carcinogen? (source)[e]	Exposure Potential (all routes without regard to PPE)
Chloride	TLV not established	No information available	No information available	No information available	No information available	90% of the waste is containerized. The remaining waste will be managed under appropriate work control documentation.
Chromium	TWA: 1 mg/m^3	Ih, Ig, Con	Eye and skin irritation; lung fibrosis	Eyes, skin, respiratory system	No	90% of the waste is containerized. The remaining waste will be managed under appropriate work control documentation.
Cobalt	TWA: 0.1 mg/m^3	Ih, Ig, Con	Cough, dyspnea, wheezing, decreased pulmonary function; weight loss; dermatitis; diffuse nodular fibrosis; respiratory hypersensitivity, asthma	Skin, respiratory system	No	90% of the waste is containerized. The remaining waste will be managed under appropriate work control documentation.
Copper	TWA: 1 mg/m^3	Ih, Ig, Con	Eyes, nose, and pharynx irritation; nasal septum perforation; metallic taste; dermatitis; lung, liver, kidney damage; anemia	Eyes, skin, respiratory system, liver, kidneys	No	90% of the waste is containerized. The remaining waste will be managed under appropriate work control documentation.
Cyanide	TLV not established	No information available	No information available	No information available	No information available	90% of the waste is containerized. The remaining waste will be managed under appropriate work control documentation.

Table 2-3. (continued)

Material or Chemical (CAS #, Vapor Density & Ionization Energy)[a]	Exposure Limit[b] (PEL/TLV)	Routes of Exposure[c]	Indicators or Symptoms of Over-Exposure[d] (Acute and Chronic)	Target Organs/System	Carcinogen? (source)[e]	Exposure Potential (all routes without regard to PPE)
Dysprosium	TLV not established	Ih, Ig, S, Con	Eye, skin, digestive, and respiratory system irritation	Eye, skin, GI, respiratory system	No	90% of the waste is containerized. The remaining waste will be managed under appropriate work control documentation.
Fluoride	TLV not established	No information available	No information available	No information available	No information available	90% of the waste is containerized. The remaining waste will be managed under appropriate work control documentation.
Iron	TWA: 5 mg/m^3	Ih, Ig, Con	Eyes and mucous membrane irritation; abdominal pain, diarrhea, vomiting; possible liver damage	Eyes, respiratory system, liver, GI	No	90% of the waste is containerized. The remaining waste will be managed under appropriate work control documentation.
Lead	TWA: 0.050 mg/m^3	Ih, Ig, Con	Weakness, lassitude, insomnia; facial pallor; anorexia, weight loss, malnutrition; constipation, abdominal pain, colic; anemia; gingival lead line; tremor; paralysis wrist, ankles; encephalopathy; kidney disease; irritation eyes; hypotension	Eyes, GI, CNS, kidneys, blood, gingival tissue	No	90% of the waste is containerized. The remaining waste will be managed under appropriate work control documentation.

Table 2-3. (continued)

Material or Chemical (CAS #, Vapor Density & Ionization Energy)[a]	Exposure Limit[b] (PEL/TLV)	Routes of Exposure[c]	Indicators or Symptoms of Over-Exposure[d] (Acute and Chronic)	Target Organs/System	Carcinogen? (source)[e]	Exposure Potential (all routes without regard to PPE)
Magnesium	TLV: 10 mg/m^3 (as magnesium oxide fume)	Ih, Con	Eye and nose irritation; metal fume fever (cough; chest pain; flu-like fever); abdominal pain; diarrhea	Eyes, respiratory system, GI	No	90% of the waste is containerized. The remaining waste will be managed under appropriate work control documentation.
Manganese	TWA: 1 mg/m^3	Ih, Ig	Parkinson's; asthenia, insomnia, mental confusion; metal fume fever: dry throat, cough, chest tightness, dyspnea, rales, flu-like fever; low-back pain; vomiting; malaise; fatigue; kidney damage	Respiratory system, CNS, blood, kidneys	No	90% of the waste is containerized. The remaining waste will be managed under appropriate work control documentation.
Mercury	TWA: 0.05 mg/m^3 – skin	Ih, Ig, S, Con	Irritation eyes, skin; cough, chest pain, dyspnea, bronchitis pneumonitis; tremor, insomnia, irritability, indecision, headache, fatigue, weakness; stomatitis, salivation; gastrointestinal disturbance, anorexia, weight loss; proteinuria	Eyes, skin, respiratory system, CNS, kidneys	No	90% of the waste is containerized. The remaining waste will be managed under appropriate work control documentation.
Molybdenum	TWA: 15 mg/m^3	Ih, Ig, Con	Eyes, nose, and throat irritation; anorexia, diarrhea, weight loss; listlessness; liver, kidney damage	Eyes, respiratory system, liver, kidneys	No	90% of the waste is containerized. The remaining waste will be managed under appropriate work control documentation.

Table 2-3. (continued)

Material or Chemical (CAS #, Vapor Density & Ionization Energy)[a]	Exposure Limit[b] (PEL/TLV)	Routes of Exposure[c]	Indicators or Symptoms of Over-Exposure[d] (Acute and Chronic)	Target Organs/System	Carcinogen? (source)[e]	Exposure Potential (all routes without regard to PPE)
Nickel	TWA: 1 mg/m^3	Ih, Ig, Con	Sensitization dermatitis, allergic asthma, pneumonitis	Nasal cavities, lungs, skin	Yes – NIOSH	90% of the waste is containerized. The remaining waste will be managed under appropriate work control documentation.
Nitrate	TLV not established	No information available	No information available	No information available	No information available	Low hazard. 90% of the waste is containerized. The remaining waste will be managed under appropriate work control documentation.
Nitrate/Nitrite-N	TLV not established	No information available	No information available	No information available	No information available	Low hazard. 90% of the waste is containerized. The remaining waste will be managed under appropriate work control documentation.
Nitrite	TLV not established	No information available	No information available	No information available	No information available	Low hazard. 90% of the waste is containerized. The remaining waste will be managed under appropriate work control documentation.
Phosphorus	TWA: 0.1 mg/m^3	Ih, Ig, Con	Eye and respiratory tract irritation; eye and skin burns; abdominal pain, nausea, jaundice; anemia; cachexia; dental pain, salivation, jaw pain, swelling	Eyes, skin, respiratory system, liver, kidneys, jaw, teeth, blood	No	90% of the waste is containerized. The remaining waste will be managed under appropriate work control documentation.

Table 2-3. (continued)

Material or Chemical (CAS #, Vapor Density & Ionization Energy)[a]	Exposure Limit[b] (PEL/TLV)	Routes of Exposure[c]	Indicators or Symptoms of Over-Exposure[d] (Acute and Chronic)	Target Organs/System	Carcinogen? (source)[e]	Exposure Potential (all routes without regard to PPE)
Potassium	TLV not established	Ih, Ig, S, Con	May cause burns to body tissue	Skin	No	90% of the waste is containerized. The remaining waste will be managed under appropriate work control documentation.
Selenium	TWA: 0.2 mg/m^3	Ih, Ig, Con	Eyes, skin, nose, and throat irritation; visual disturbance; headache; chills, fever; dyspnea, bronchitis; metallic taste, garlic breathing, gastrointestinal disturbance; dermatitis; eye, skin burns; anemia; liver necrosis, cirrhosis; kidney, spleen damage	Eyes, skin, respiratory system, liver, kidneys, blood, spleen	No	90% of the waste is containerized. The remaining waste will be managed under appropriate work control documentation.
Silver	TWA: 0.01 mg/m^3	Ih, Ig, Con	Blue-gray eyes, nasal septum, throat, skin; irritation, ulceration skin; gastrointestinal disturbance	Nasal septum, skin, eyes	No	90% of the waste is containerized. The remaining waste will be managed under appropriate work control documentation.
Sodium	TLV not established	Ih, Ig, S, Con	Mucous membranes and upper respiratory tract damage; nose and throat irritation; lung edema; burns and tissue destruction; eye damage; dermatitis	Skin, respiratory system, eyes	No	90% of the waste is containerized. The remaining waste will be managed under appropriate work control documentation.

Table 2-3. (continued)

Material or Chemical (CAS #, Vapor Density & Ionization Energy)[a]	Exposure Limit[b] (PEL/TLV)	Routes of Exposure[c]	Indicators or Symptoms of Over-Exposure[d] (Acute and Chronic)	Target Organs/System	Carcinogen? (source)[e]	Exposure Potential (all routes without regard to PPE)
Strontium	No information available as Sr. See specific form for TLV.	No information available	No information available	No information available	No information available	90% of the waste is containerized. The remaining waste will be managed under appropriate work control documentation.
Sulfate	TLV not established	No information available	No information available	No information available	No information available	90% of the waste is containerized. The remaining waste will be managed under appropriate work control documentation.
Sulfide	TLV not established	No information available	No information available	No information available	No information available	90% of the waste is containerized. The remaining waste will be managed under appropriate work control documentation.
Terbium	TLV not established	Ih, Ig, S, Con	Eye, skin, respiratory, and GI system irritation	Eyes, skin, GI, respiratory system	No	90% of the waste is containerized. The remaining waste will be managed under appropriate work control documentation.
Thallium	TWA: 0.1 mg/m^3 – skin	Ih, Ig, S, Con	Polyneuritis, optic nerve atrophy, encephalopathy, cardiac disturbances, liver and kidney damage, alopecia; vision, nervous system, skin (hair), heart, gastrointestinal tract, human reproduction problems	CNS, peripheral nervous system, liver, kidneys, GI, skin, cardiovascular system, eyes, heart, human reproduction	No	90% of the waste is containerized. The remaining waste will be managed under appropriate work control documentation.

Table 2-3. (continued)

Material or Chemical (CAS #, Vapor Density & Ionization Energy)[a]	Exposure Limit[b] (PEL/TLV)	Routes of Exposure[c]	Indicators or Symptoms of Over-Exposure[d] (Acute and Chronic)	Target Organs/System	Carcinogen? (source)[e]	Exposure Potential (all routes without regard to PPE)
Vanadium	TLV not established	Ih, Ig, S, Con	Causes severe eye, skin, respiratory, and GI system irritation; vomiting, diarrhea, nausea	Eyes, skin, GI, respiratory system	No	90% of the waste is containerized. The remaining waste will be managed under appropriate work control documentation.
Zinc	TWA: 10 mg/m^3 (zinc oxide fume)	Ih, Ig, S, Con	Eye, skin, respiratory, and GI system irritation	Eyes, skin, GI, gum tissue, respiratory, kidneys	No	90% of the waste is containerized. The remaining waste will be managed under appropriate work control documentation.
Zirconium	TWA: 5 mg/m^3	Ih, Con	Skin, lung granulomas; irritation skin, mucous membrane; X-ray evidence of retention in lungs	Skin, respiratory system	No	90% of the waste is containerized. The remaining waste will be managed under appropriate work control documentation.
Radionuclides (Ac-225, Ac-227, Ac-228, Ba-136m, Ba-137m, Ba-140, Be-10, C-14, Ce-141, Ce-142, Ce-144, Co-57, Co-58, Co-60, Cr-51, Cs-132, Cs-134, Cs-135, Cs-136, Cs-137, Eu-150, Eu-152, Eu-154, Fe-59, Gd-152, Gd-153, H-3, I-129, I-131, K-40, Kr-81, Kr-85, La-138, La-140, Mn-54, Nb-92, Nb-93m, Nb-94, Nb-95, Nb-95m, Nd-144, Nd-147, Np-235, Np-236, Np-237, Np-238, Pa-231, Pa-233, Pa-234, Pa-234m, Pm-146, Pm-147, Pm-148, Pm- 148m, Pr-143, Pr-144, Pr-144m, Ra-222, Ra-223, Ra-224, Ra-225, Ra-226, Ra-228, Rb-86, Rb-87, Rh-102, Rh-103m, Ru-103, Ru-106, Sc-46, Se-79, Sm-146, Sm-147, Sm-148, Sm-149, Sm-151, Sr-89, Sr-90, Tc-98, Tc-99, Th-226, Th-227, Th-228, Th-229, Th-230, Th-231, Th-232, Th-234, U-230, U-232, U-233, U-234, U-235, U- 236, U-237, U-238, U-240, Xe-129m, Xe-131m, Xe-133, Y-90, Y-91, Zn-65, Zr-93, Zr-95)						
Radionuclides (whole body exposure from hot particle)	ALARA, dose limit-per radiological work permit Posting of radiation areas per applicable company policies and procedures	Whole Body	If required, alarming electronic dosimetry will be used to alert workers to increased gamma radiation fields. TLDs for whole body TEDE	Blood-forming cells, GI tract, and rapidly dividing cells	Yes – IARC	Low – moderate potential. Many waste streams are mixed low-level waste. Dose rate will be noted on shipping paperwork for each package.

Table 2-3. (continued)

Material or Chemical (CAS #, Vapor Density & Ionization Energy)[a]	Exposure Limit[b] (PEL/TLV)	Routes of Exposure[c]	Indicators or Symptoms of Over-Exposure[d] (Acute and Chronic)	Target Organs/System	Carcinogen? (source)[e]	Exposure Potential (all routes without regard to PPE)
Radionuclides (fixed and removable surface contamination)	Posting of contamination areas per applicable company policies and procedures	Ig, Con	Portable contamination instruments, swipes, and personal contamination monitor.	GI tract, ionization of internal tissue	Yes – IARL	Low potential. Contact with contaminated soil/debris should be minimal.

a. Material Safety Data Sheets (MSDSs) for chemicals other than waste types are available at the ICDF.

b. American Conference of Governmental Industrial Hygienists (ACGIH) 2000 TLV Booklet and OSHA, 29 CFR 1910, substance-specific standards.

c. (Ih) inhalation; (Ig) ingestion; (S) skin absorption; (Con) contact hazard.

d. (Nervous system) dizziness/nausea/lightheadedness; (dermis) rashes/itching/redness; (respiratory) respiratory effects; (eyes) tearing/irritation.

e. If yes, identify agency and appropriate designation (ACGIH A1 or A2, NIOSH, OSHA, IARC, NTP).

CNS = central nervous system	GI = gastrointestinal	IARC = International Agency for Research on Cancer	IH = industrial hygienist
NTP = National Toxicology Program	PEL = permissible exposure limit	RCM = radiological control manual	TEDE = total effective dose equivalent
TLV = threshold-limit value	TLD = thermoluminescent dosimeter	NIOSH = National Institute of Occupational Safety and Health	TWA = time-weighed average

Table 2-4. Summary of ICDF operational activities, associated hazards, and mitigation[a].

Activity or Task	Associated Hazards or Hazardous Agent	Hazard Mitigation
Waste Loading and Offloading in Cells	Radiological contamination—waste material. Radiation exposure—chemical exposure, waste containers (with a dose rate).	Radiological control technician (RCT) surveys, hold points, radiological work permit (RWP) (as required), direct-reading instruments, compliance with applicable company radiological posting requirements, PPE, and use of dosimetry/survey requirements.
Equipment Operations	Chemical and inorganic contaminants—waste material, chemical usage for ICDF operations.	Controlled areas, qualified operators, JSAs, safe work permits (SWPs) (as required), technical procedures (TPRs), or work packages, Material Safety Data Sheet (MSDS) for all chemicals used, and PPE.
General ICDF Facility Operations	Respirable dust—silica in dust.	Use established roads, wet road and areas as necessary to minimize dust, conduct baseline and periodic air monitoring to establish exposure levels for affected personnel.
	Equipment movement and vehicle traffic—trailers, forklift, truck pinch points; and struck-by or caught-between potential.	JSAs, TPRs, qualified heavy equipment operator (hoisting and rigging)/forklift operators, designated traffic lanes and areas, watch body position, and wear PPE.
	Lifting and back strain—staging waste containers and support materials, lifting/carrying hoisting and rigging equipment.	Mechanical equipment movement, proper lifting techniques, and two-person lifts, body position awareness.
	Heat and cold stress—working outdoors	IH monitoring and work-rest cycles as required.
	Tripping hazards and working-walking surfaces—uneven surfaces/terrain, ice- and snow-covered surfaces, and truck decks, and ladders.	Awareness of walking surfaces, salt and sand icy areas, and use nonskid or high-fiction materials on walking surfaces, 3-point contact when ascending/descending ladder.
	Stored energy sources—elevated materials, electrical, compressed gases, potential hoisting and rigging (H&R), rolling vehicles.	Identify and mark all utilities, ensure all lines and cords are checked for damage and continuity, use ground-fault circuit interrupter (GFCI) on outdoor equipment, comply with minimum clearances for overhead lines, and secure compressed cylinders, caps, and bottles before movement, conduct inspections of H&R equipment, set brake and use tire chalks where appropriate.
	Hazardous noise—areas around equipment and when operating some equipment.	Source identification/labeling, IH sound level monitoring and/or dosimetry, isolation, and PPE (as required).

Table 2-4. (continued).

Activity or Task	Associated Hazards or Hazardous Agent	Hazard Mitigation
Waste Transportation at ICDF	Radiological contamination—exterior waste container surface (potential only). Radiation exposure—waste containers (with a dose rate).	RCT surveys, hold points, RWP (as required), direct-reading instruments, compliance with applicable company radiological posting requirements, PPE, and use of dosimetry/survey requirements.
	Chemical and inorganic contaminants—exterior waste container surface (potential only).	Controlled areas, qualified operators, JSAs, SWP (as required), TPRs or work package, and PPE.
	Equipment and vehicle movement—trailers, forklift, truck-trailer/chain pinch points; ergonomic concerns; and struck-by or caught-between potential.	Trained drivers, JSAs, TPRs, qualified forklift operators, designated traffic lanes and parking areas, watch body position, wear required PPE.
	Lifting and back strain—positioning waste on trailer and securing/removing straps or chains from loads, and moving support materials.	Use forklift to position load on trailer, proper lifting techniques, two-person lifts (as required), be aware of body position, and use strap or chain tightening device properly.
	Heat and cold stress—working outdoors	IH monitoring and work-rest cycles (as required).
	Tripping hazards and working-walking surfaces—uneven surfaces/terrain, ice- and snow-covered surfaces, and truck decks, and fall hazard.	Awareness of walking surfaces, salt and sand icy areas, and use nonskid or high-fiction materials on walking surfaces, wear adequate footwear with traction sole, be aware of edge of trailer when securing/removing load straps/chains.
Cell Grading and Heavy Equipment Operations	Radiological contamination—contact with waste material/containers only. Radiation exposure—In close proximity to waste containers (with a dose rate).	RCT surveys, hold points, RWP (as required), direct-reading instruments, compliance with applicable company radiological posting requirements, PPE, and use of dosimetry/survey requirements.
	Chemical and inorganic contaminants—waste material, fuels, lubricants.	Controlled areas, qualified operators, JSAs, SWPs (as required), TPRs, or work packages, PPE, MSDS for all chemical products.
	Respirable dust—silica in dust.	Use established roads, wet road/cell and areas as necessary to minimize dust, conduct baseline and periodic air monitoring to establish exposure levels for affected personnel.

Table 2-4. (continued).

Activity or Task	Associated Hazards or Hazardous Agent	Hazard Mitigation
	Equipment movement and vehicle traffic—trailers, heavy equipment, pinch points; and struck-by or caught-between potential, overhead hazards.	Qualified equipment operators, JSAs, TPRs, equipment operator (hoisting and rigging), designated traffic lanes and areas, watch body position, maintain electrical line clearances, and wear PPE.
	Lifting and back strain—moving and carrying rigging	Proper lifting techniques and two-person lifts as required.
	Heat and cold stress—working outdoors	IH monitoring and work-rest cycles as required.
	Tripping hazards and working-walking surfaces—uneven surfaces/terrain, ice- and snow-covered surfaces.	Awareness of walking surfaces, salt and sand icy areas, and use nonskid or high-fiction materials on walking surfaces, wear adequate footwear with traction sole.
	Hazardous noise—areas around equipment and when operating some equipment.	Source identification/labeling, IH sound level monitoring and/or dosimetry, isolation, and PPE (as required).
Decontamination Tasks	Radiological contamination—contact with waste material/contaminated equipment/components. Radiation exposure—In close proximity to waste containers/contamination with associated dose rate.	RWP, RCT surveys, hold points, direct-reading instruments, collection/counting of swipes, compliance with applicable company radiological posting requirements, PPE, and use of dosimetry/survey requirements, and ALARA principles (Section 4).
	Chemical and inorganic contaminants—contact with waste material/contaminated equipment/components.	Controlled areas, JSAs, SWPs (as required), TPRs, or work packages, and PPE.
	Pinch points, struck-by/caught-between—equipment/ component movement.	JSAs, TPRs, watch body position, and wear PPE.
	Lifting and back strain—moving and positioning components.	Proper lifting techniques and two-person lifts as required, IH conduct ergonomic evaluation of tasks (as required).
	Heat and cold stress—working outdoors and in PPE	IH monitoring and work-rest cycles as required.
	Tripping hazards and working-walking surfaces—uneven surfaces/terrain, ice- and snow-covered and wet surfaces.	Awareness of walking surfaces, salt and sand icy areas, and use nonskid or high-fiction materials on walking surfaces, wear adequate footwear with traction sole.

Table 2-4. (continued).

Activity or Task	Associated Hazards or Hazardous Agent	Hazard Mitigation
	Electrical—use of electrical equipment or equipment in area where water of wet surfaces are present.	JSA, TPR or work package, use of GFCI outlets or extension cords outdoors and where water or wet surfaces are present, use of barrier material to isolate overspray.
Maintenance of ICDF systems – Electrical – Piping and plumbing (including SSSTF) – Communication – Heating, ventilating, and air conditioning (HVAC) – Roads	Radiological contamination—contact with waste material/contaminated equipment/components. Radiation exposure—in close proximity to waste containers/contamination with associated dose rate.	RWP, RCT surveys, hold points, direct-reading instruments, collection/counting of swipes, compliance with applicable company radiological posting requirements, PPE, and use of dosimetry/survey requirements, and ALARA principles (Section 4).
	Chemical and inorganic contaminants—contact with waste material/contaminated equipment/components, use of chemicals associated with maintenance.	Controlled areas, JSAs, SWPs (as required), TPRs, or work packages, MSDS for all chemicals, and PPE.
	Pinch points, struck-by/caught-between—equipment/component movement, installation or removal.	JSAs, TPRs, watch body position, and wear PPE.
	Lifting and back strain—moving and positioning components.	Use mechanical lifting and positioning devices, proper lifting techniques and two-person lifts as required, IH conduct ergonomic evaluation of tasks (as required).
	Heat and cold stress—working outdoors and in PPE	IH monitoring and work-rest cycles as required.
	Tripping hazards and working-walking surfaces—uneven surfaces/terrain, ice- and snow-covered and wet surfaces.	Awareness of walking surfaces, salt and sand icy areas, and use nonskid or high-fiction materials on walking surfaces, wear adequate footwear with traction sole.
	Hoisting and rigging—equipment/component movement and placement, ICDF overhead hoists.	Qualified operators, equipment/rigging inspections, H&R operations per applicable company policies and procedures.
	Stored energy—electrical, mechanical, thermal, elevated materials, pressurized systems/cylinders/fire systems.	Piping/conduit labeling, lockout/tagout (LO/TO) training, applicable work packages, LO/TO applicable company policies and procedures.

a. All hazards will be identified, evaluated, and controls established in accordance with applicable company policy and procedure requirements. Additionally, ICDF assigned IH, Safety Professional, and Radiological Control (RadCon) personnel will be available to assist with the applicable company policies and procedures process and to assist in the develop of TPRs, work orders/packages, and permits associated with ICDF operational activities.

2.1.1 Routes of Exposure

Exposure pathways exist for radiological and nonradiological contaminants encountered during ICDF operations. Engineering controls, monitoring, training, and work controls will mitigate potential contact and uptake of these hazards; however, the potential for exposure to contaminants still exists. Exposure pathways include those listed below:

- **Inhalation** of radiological and nonradiological contaminated soil or fugitive dusts during waste handling, disposal, or decontamination tasks. Inhalable or respirable (dependent on the particle aerodynamic diameter) fugitive dusts may have trace amounts of radiological or nonradiological contaminants associated with them, resulting in potential respiratory tract deposition.

- **Skin absorption and contact** with radiological and nonradiological contaminated soil or surfaces during waste handling, disposal, decontamination, or system maintenance tasks. Radiological and nonradiological contaminants can be absorbed through the skin, resulting in uptake through the skin and/or skin contamination.

- **Ingestion** of radiological and nonradiological contaminated soil or materials adsorbed to dust particles or waste residues, resulting in potential uptake of contaminants through the gastrointestinal (GI) tract that may result in GI irritation, internal tissue irradiation, and/or deposition to target organs.

- **Injection** of radiological and nonradiological contaminated materials by breaking of the skin or migration through an existing wound, resulting in localized irritation, contamination, uptake of soluble contaminants, and deposition of insoluble contaminants.

Chemical and radiological hazards will be eliminated, isolated, or mitigated to the extent possible during all ICDF operations. Where they cannot be eliminated or isolated, monitoring for chemical and radiological hazards will be conducted (as described in Section 3) to detect and quantify exposures. Additionally, administrative controls, training, work procedures, and protective equipment will be used to further reduce the likelihood of exposure to these hazards. Table 2-4 summarizes each primary operational activity, associated hazards, and mitigation procedures.

The JSAs, SWPs, radiological work permits (RWPs), and TPRs will be used in conjunction with this HASP to address specific hazardous operations (e.g., hot work) and radiological conditions for ICDF operations. When used, these permits will further detail specialized PPE and dosimetry requirements.

2.2 Radiological Exposure Control

Radiation exposure limits are based on requirements contained in Subpart C of 10 CFR 835 and company policies and procedures. An administrative control level has been established for the INEEL. For nonaccident conditions, company management must give prior written approval for doses greater than the INEEL administrative control level. The administrative limit imposed by DOE is to keep worker exposure less than 2 rem/yr. DOE-HQ management must give prior written approval for doses greater than 2 rem/yr, but a worker will not be authorized to receive an exposure greater than 5 rem/yr. In addition, radiation workers have assigned ALARA goals. The dose limits and ALARA goals are implemented in company procedures and apply to occupational radiation dose, which excludes doses from background, therapeutic and diagnostic radiation, medical radiation, and participation as a subject in medical research programs.

The radiation dose limit for the unrestricted public exposure scenario (i.e., Highway 26 Rest Area visitor) and the member of the public entry (i.e., INEEL visitor, ICDF visitor) is 0.015 rem/year. This dose limit is developed for members of the public who are unknowingly exposed to radiation and is approximately equivalent to an excess lifetime cancer risk of 1×10^{-4}. The visitors may be permitted to enter fenced areas of the ICDF Complex but will be restricted to administrative areas only, until they have been through appropriate awareness training. Until such training has been completed visitors will be denied access to Radiological Buffer Areas (RBAs), Radiological Areas, or Contamination Areas to ensure they have no radiological exposure.

It is anticipated the average visitor to the ICDF landfill will not enter Controlled Radiation Areas. Visitors allowed to enter Controlled Radiation Areas will be escorted by trained ICDF personnel. The visitor will be provided information on radiation exposures, radiation doses, anticipated levels of exposure based upon visit duration, and area levels; and the visitor must be willing to accept the risks of radiation exposure. This training will be conducted prior to and every time the visitor is allowed access the site. These escorted visitors will be provided radiation dosimetry to maintain exposure records within occupational protective levels. Radiological exposures will be mitigated to acceptable levels that are protective of occupational personnel. Because occupational personnel exposure are maintained below established limits, the visitor is also protected due to reduced exposure frequency and duration

The total effective dose equivalents for the nonradiation worker scenarios are far below the radiation dose limit of 0.1 rem/year. It is important to note that the total effective dose equivalent values calculated for the nonradiation worker exposure scenarios are based on unmitigated risk. In no event will workers be allowed to exceed the regulatory limit of 0.1 rem/year for occupational exposures. By accepting the dosimeter, the visitor has accepted the risk of possible exposure and is automatically entered into the INEEL dose tracking system.

The visitor entering radiological controlled areas will be required to complete the level of training for entry, including Radiation Worker I or Radiation Worker II, to have unescorted access in addition to having dosimetry. Radiation safety training commensurate with the hazards and required controls is required before unescorted access to Radiological Areas is permitted. The radiation dose limit for the informed visitor is 0.1 rem/year (10 CFR 835). This dose limit is developed for members of the public who have received radiation training/briefing and who understand and are willing to accept the risks of radiation exposure. Visitor radiological exposure records are maintained and tracked to ensure their annual exposures limits are not exceeded. If a visitor reaches the established radiological limits, their access to radiological areas will be removed until the following calendar year. Records are tracked by social security numbers for visitors. Dosimetry will not be issued to visitors who have reached the administrative radiological exposure limits serving as the access control method.

The ICDF Complex will be managed to ensure that (1) acceptable short-term risk levels will be met for members of the community and nonradiation workers, and (2) OSHA and DOE dose limits will not be exceeded for radiation workers. The primary methods used to control workplace exposure are facility and equipment design features. These controls are augmented with both area entry/exit requirements that control access to and from radiological areas and RWPs that control radiological work. In addition, proposed maintenance and modification plans are reviewed to identify and incorporate radiological protection requirements.

The INEEL's procedure for posting Radiological Control Areas specifies requirements for entering and exiting radiological areas. Safe Work and RWPs function as the primary controls for entry into radiological areas. Signs and barricades further augment these controls.

The automated Radiological Control Information Management System is used to record entrance to or departure from the controlled area. If a visitor enters an area requiring electronic dosimeter, the visitor is electronically logged into the controlling RWPs and is issued a supplemental dosimeter. The visitor's radiological training and current dose is checked to ensure that the training is current and that the visitor's dose is within current limits.

During visitor egress, the system then checks back in the electronic dosimeters and adds the dosimeter results to the visitor's current total. The visitor is also logged out of the Radiation Work Permits. In the event that the automated system is unavailable (such as during system outages), a standby paper system is used until the system is operational.

2.3 Safety and Physical Hazards and Mitigation

Industrial safety and physical hazards will be encountered while performing ICDF operations. Section 4.2 provides general safe-work practices that must be followed at all times. The following sections describe specific industrial safety hazards and procedures to be followed to eliminate or minimize potential hazards to project personnel.

2.3.1 Material Handling and Back Strain

Material handling and maneuvering of various pieces of equipment during ICDF operations may result in employee injury. All lifting and material-handling tasks will be performed in accordance with applicable company policies and procedures. Personnel will not physically lift objects weighing more than 22 kg (50 lb) or 33% of their body weight (whichever is less) alone. Additionally, back strain and ergonomic considerations must be given to material handling and equipment usage. Mechanical and hydraulic lifting devices should be used to move materials whenever possible. The IH will conduct ergonomic evaluations of various ICDF operations to determine the potential ergonomic hazards and provide recommendations to mitigate these hazards. Applicable requirements from company policies and procedures also will be followed.

2.3.2 Repetitive Motion and Musculoskeletal Disorders

ICDF operational tasks to be conducted may expose personnel to repetitive-motion hazards, undue physical stress, overexertion, awkward postures, or other ergonomic risk factors that may lead to musculoskeletal disorders. Musculoskeletal disorders can cause a number of conditions including pain, numbness, tingling, stiff joints, difficulty moving, muscle loss, and sometimes paralysis. The assigned project IH will evaluate project tasks and provide recommendations to reduce the potential for musculoskeletal disorders in accordance with applicable company policies and procedures.

2.3.3 Working and Walking Surfaces

Slippery work surfaces can increase the likelihood of back injuries, overexertion injuries, slips, and falls. Outdoor ICDF operations presents inherent tripping hazards because of uneven surfaces and terrain. Additionally, the potential for slip, trip, and fall hazards will increase during winter months because of ice- and snow-covered surfaces. All personnel will be made aware of tripping hazards that cannot be eliminated. Tripping and slip hazards will be evaluated during the course of the project in accordance with applicable company policies and procedures.

2.3.4 Elevated Work Areas

Personnel may sometimes be required to work on elevated equipment or at heights above 1.8 m (6 ft). During such work, employees will comply with requirements from applicable company policies and procedures. Where required, a fall protection plan will be written.

2.3.5 Powered Equipment and Tools

Powered equipment and tools used during ICDF operations present potential physical hazards (e.g., pinch points, electrical hazards, flying debris, struck-by, and caught-between) to personnel operating them. All portable equipment and tools will be properly maintained and used by qualified individuals and in accordance with the manufacturer's specifications. At no time will safety guards be removed. Requirements from applicable company policies and procedures will be followed for all work performed with powered equipment including hand tools. All tools will be inspected by the user before use.

2.3.6 Electrical Hazards and Energized Systems

Electrical equipment and tools, as well as overhead and underground lines associated with ICDF operations, may pose shock or electrocution hazards to personnel. Safety-related work practices will be employed to prevent electric shock or other injuries resulting from direct or indirect electrical contact. If work on energized systems is necessary, these practices will conform to applicable company policies and procedures and Parts I through III of the National Fire Protection Act 70E. In addition, all electrical work will be reviewed and completed under the appropriate work controls (e.g., TPRs and work orders). When working around overhead lines, clearances will be maintained at all times. Additionally, all underground utilities and installations will be identified before conducting excavation activities in accordance with applicable company policies and procedures.

2.3.7 Fire and Flammable Materials Hazards

Fuel will be required for equipment usage during ICDF operations. Flammable hazards may include (1) transfer and storage of flammable or combustible liquids in the ICDF operations area and (2) chemical reaction (reduction, oxidation, exothermic, etc.) from incompatible waste materials. Portable fire extinguishers with a minimum rating of 10A/60BC shall be strategically located at the facility to combat Class ABC fires. They will be located in all active ICDF operations areas, on or near all facility equipment that have exhaust heat sources, and on or near all equipment capable of generating ignition or having the potential to spark. Applicable company policies and procedures will be consulted when storing ICDF chemicals. Additionally, a fire hazards analysis will be prepared for the ICDF in accordance with applicable company policies and procedures.

2.3.7.1 Combustible Materials. Combustible or ignitable materials in contact with or near exhaust manifolds, catalytic converters, or other ignition sources could result in a fire. An INTEC fire protection engineer should be contacted if questions arise about potential ignition sources. The accumulation of combustible materials will be strictly controlled at the ICDF. Disposal of combustible materials will be assessed at the end of each shift. Class A combustibles such as trash, cardboard, rags, wood, and plastic will be properly disposed of in appropriate waste containers. The fire protection engineer also may conduct periodic site inspections to ensure all fire protection requirements are being met.

2.3.7.2 Flammable and Combustible Liquids. Fuel used at the ICDF for fueling must be safely stored, handled, and used. Only flammable liquid containers approved by the Factory Mutual and Underwriters Laboratories and labeled with the contents will be used to store fuel. All fuel containers will be stored at least 15 m (50 ft) from any facilities and ignition sources or they will be stored inside an

approved flammable storage cabinet. Additional requirements are provided in applicable company policies and procedures. Portable motorized equipment (e.g., generators and light plants) will be shut off and allowed to cool down in accordance with the manufacturer's operating instructions before being refueled to minimize the potential for a fuel fire.

2.3.7.3 Welding, Cutting, or Grinding. Personnel conducting welding, cutting, or grinding tasks may be exposed to molten metal, slag, and flying debris. Additionally, a fire potential exists if combustible materials are not cleared from the work area. Requirements from applicable company policies and procedures will be followed whenever these types of activities are conducted.

2.3.8 Pressurized Systems

Compressor will be operated in support of ICDF operations. The hazards presented to personnel, equipment, facilities or the environment because of inadequately designed or improperly operated pressure systems (vessels) include blast effects, shrapnel, fluid jets, equipment damage, personnel injury, and death. These systems can include pneumatic, hydraulic or compressed gas systems. The applicable company policies and procedures and the manufacturer's operating and maintenance instructions must be followed. This includes inspection, maintenance, and testing of systems and components in conformance with applicable American National Standards Institute (ANSI) requirements.

All pressure systems will be operated in the designed operating pressure range, which is typically 10 to 20% less than the maximum allowable working pressure. Additionally, all hoses, fittings, lines, gauges, and system components will be rated for the system for at least the maximum allowable working pressure (generally the relief set point). The project safety professional should be consulted about any questions of pressure systems in use at the project site.

2.3.9 Cryogenics

Cryogenic may be used in support of ICDF operations. If required, all cryogenic tasks will be conducted and protective equipment worn in accordance with applicable company policies and procedures. Personal protective equipment will be worn at all times when handling, transferring, or dispensing cryogenic liquids in accordance with applicable company policies and procedures.

2.3.10 Compressed Gases

Compressed gases may be used in support of ICDF operations. If used, all cylinders will be used, stored, handled, and labeled in accordance with applicable company policies and procedures. Additionally, the assigned ICDF safety professional should be consulted about any compressed gas cylinder storage, transport, and usage issues.

2.3.11 Heavy Equipment and Moving Machinery

Hazards associated with the operation of heavy equipment include injury to personnel (e.g., struck-by and caught-between hazards) and equipment and property damage. All heavy equipment will be operated in the manner in which it was intended and in accordance with manufacturer's instructions. Only authorized qualified personnel will be allowed to operate equipment and personnel near operating heavy equipment and must maintain visual communication with the operator. Personnel will comply with applicable company policies and procedures.

ICDF personnel working around or near cranes or boom trucks will also comply with applicable company policies and procedures as applicable and appropriate.

Additional safe practices will include the following:

- All heavy equipment will have backup alarms.
- Walking directly behind or to the side of heavy equipment without the operator's knowledge is prohibited. All precautions will be taken before moving heavy equipment.
- While operating heavy equipment in the work area, the equipment operator will maintain communication with a designated person who will be responsible for providing direct voice contact or approved standard hand signals. In addition, all facility personnel in the immediate work area will be made aware of the equipment operations.
- All equipment will be kept out of traffic lanes and access ways and will be stored so as not to endanger personnel at any time.
- All unattended equipment will have appropriate reflectors or be barricaded if left on roadways.
- All parked equipment will have the parking brake set and chocks will be used when equipment is parked on inclines.
- The swing radius of heavy equipment will be adequately barricaded or marked to prevent personnel from entering into the swing radius.

2.3.12 Excavation, Surface Penetrations, and Outages

Operation of the ICDF may require limited excavation activities in conjunction with grading operations as disposal cells are used. All surface penetrations and related outages will be coordinated through the field supervisor and will require submittal of an outage request for outages (e.g., road, electrical, and water). The submission of an outage request will not be considered an approval to start the work. Other specific outage requirements are addressed in the special conditions section of the management and operating contract. No surface penetrations will be allowed or conducted until the area has been evaluated and an approved subsurface evaluation documented.

All excavation activities will be conducted and monitored in accordance with applicable company policies and procedures and 29 CFR 1926, Subpart P, "Excavations." The following are some key elements from these requirements:

- The location of utility installations (e.g., sewer, telephone, fuel, electric, water lines, or any other underground installations) that may reasonably be expected to be encountered during excavation work will be determined before opening an excavation.
- Structural ramps that are used solely by employees as a means of access or egress from excavations will be designed by a competent person. Structural ramps used for access or egress of equipment will be designed by a competent person qualified in structural design and will be constructed in accordance with the design. Structural ramps will be inspected in accordance with applicable company forms.
- Employees exposed to public vehicular traffic will be provided with and will wear warning vests or other suitable garments marked with or made of reflecting or high-visibility material.

- Daily inspections of excavations, areas adjacent to the excavations, and protective systems will be made by a competent person for evidence of a situation that could result in possible cave-ins, indications of failure of protective systems, hazardous atmospheres, or other hazardous conditions. An inspection will be conducted by the competent person before the start of work and as needed throughout the shift. Inspections also will be made after every rainstorm or other hazard-increasing occurrence.

- Sloping or benching will be constructed and maintained in accordance with the requirements set forth in 29 CFR 1926, Subpart B, Appendix B, for the soil type as classified by the competent person. This classification of the soil deposits will be made based on the results of at least one visual inspection and at least one manual analysis.

2.3.13 Hoisting and Rigging of Equipment

A hoist or winch system may be use in support of ICDF maintenance tasks. All hoisting and rigging operations will be performed in accordance with applicable company policies and procedures as applicable for these ICDF operations. Hoisting and rigging equipment will show evidence of a current inspection (e.g., tag) and be inspected before use by qualified personnel. Additionally, if mobile crane or boom trucks are used in support of ICDF operations, the operator or designated person for mobile cranes or boom trucks will perform a visual inspection each day or before use (if the crane has not been in regular service) of items such as, but not limited to, the following:

- All control mechanisms for maladjustment that would interfere with proper operation

- Crane hooks and latches for deformation, cracks, and wear

- Hydraulic systems for proper oil level

- Lines, tanks, valves, pumps, and other parts of air or hydraulic systems for leakage

- Hoist ropes for kinking, crushing, birdcaging, and corrosion

- All anti-two-block, two-block warning, and two-block damage prevention systems for proper operation.

NOTE: The operator or other designated person will examine deficiencies and determine whether they constitute a safety hazard. If deficiencies are found, they will be reported to the safety professional.

Personnel may be exposed to overhead impact (contact) hazards during the course of the ICDF operations from walking in between and around operational equipment and support structures. Sources for these hazards will be identified and mitigated in accordance with applicable company policies and procedures. In the case of overhead impact hazards, they will be marked by using engineering-controls protective systems where there is a potential for falling debris, in combination with head protection PPE.

2.3.14 Proper Housekeeping to Prevent Slips, Trips, and Falls

The floor of every workroom shall be maintained, so far as possible, in a clean and dry condition. All walking and working surfaces will be kept clean, orderly, and free of foreign objects to prevent possible slip, trip, and fall hazards. Proper drainage and use of dry standing stations will be provided where wet processes are used that could cause a potential slip and fall hazard.

Personnel shall wear appropriate footwear having proper tread for the work to be performed (consider all weather conditions); heavy/durable materials (leather); adequate ankle support; arch support; additional protection as required for the task (steel toe, steel shank, metatarsal, etc.); shock absorption, etc. Footwear can play a role in preventing slips, trips and falls. Because employees are expected to wear the proper work attire for their respective jobs, they must refrain from wearing slick-bottomed shoes during the months of inclement weather (October-May).

The evaporation ponds liner system will have a minimal coefficient of friction. Individuals will have to remain away from pond slopes and only conduct work on slopes where hazard mitigation has been provided through the use of TPRs and JSA, or SWPs.

2.3.15 Personal Protective Equipment

Wearing PPE will reduce a worker's ability to move freely, see clearly, and hear directions and noise that might indicate a hazard. In addition, PPE can increase the risk of heat stress. Work activities at the task site will be modified as necessary to ensure that personnel are able to work safely in the required PPE. Work-site personnel will comply with applicable company policies and procedures. All personnel who wear PPE will be trained in its use and limitations in accordance with applicable company policies and procedures.

2.3.16 Decontamination

Decontamination of waste containers and vehicles may be required as part of ICDF operations. Decontamination procedures for personnel and equipment are detailed in Section 11. Potential hazards to personnel conducting decontamination tasks include back strain; slip, trip, and fall hazards; and cross-contamination from contaminated surfaces. Additionally, electrical hazards may be present if powered equipment (e.g., a powered pressure washer) is used. Mitigation of these walking working surfaces and electrical hazards are addressed in other prior subsections. If a power washer or heated power washer is used, units will be operated in accordance with manufacturer's operating instructions, personnel will wear appropriate PPE to prevent high-pressure spray injuries, use ground-fault circuit protection, and these tasks will only be conducted in approved areas. Personnel will wear required PPE at all times during decontamination tasks as listed in Section 5.

2.4 Environmental Hazards and Mitigation

Potential environmental hazards will present potential hazards to personnel during ICDF operations. These hazards will be identified and mitigated to the extent possible. This section describes these environmental hazards and states what procedures and work practices will be followed to mitigate them.

2.4.1 Noise

Personnel performing ICDF operations activities may be exposed to noise levels from the heavy equipment, trucks, hand tools, and compressors that exceed 85 decibel A-weighted (dBA) for an 8-hour time-weighted average (TWA) or 83 dBA for 10-hour TWA. The effects of high sound levels (noise) may include the following:

- Personnel being startled, distracted, or fatigued
- Physical damage to the ear and pain and temporary or permanent hearing loss

- Interference with communication that would warn of danger.

Where noise levels are suspected of exceeding 80 dBA, noise measurements will be performed in accordance with applicable company policies and procedures to determine if personnel are routinely exposed to noise levels in excess of the applicable TWA (85 dBA for 8 hours of exposure or 83 dBA for 10-hour exposures).

Personnel whose noise exposure routinely meets or exceeds the allowable TWA will be enrolled in the INEEL Occupational Medical Program (OMP) (or subcontractor hearing conservation program as applicable). Personnel working on jobs that have noise exposures greater than 85 dBA (83 dBA for a 10-hour TWA) will be required to wear hearing protection until noise levels have been evaluated and will continue to wear the hearing protection specified by the IH until directed otherwise. Hearing protection devices will be selected and worn in accordance with applicable company policies and procedures.

2.4.2 Temperature and Ultraviolet Light Hazards

ICDF operational tasks will be conducted year round during times when there is a potential for both heat and cold stress that could present a potential hazard to personnel. The IH and health and safety officer (HSO) will be responsible for obtaining meteorological information to determine if additional heat or cold stress administrative controls are required. All project personnel must understand the hazards associated with heat and cold stress and take preventive measures to minimize the effects. Applicable company policy and procedure guidelines will be followed when determining work-rest schedules or when to halt work activities because of temperature extremes.

2.4.2.1 Heat Stress. High ambient air temperatures can result in increased body temperature, heat fatigue, heat exhaustion, or heat stroke that can lead to symptoms ranging from physical discomfort, unconsciousness, to death. In addition, tasks requiring the use of protective equipment or respiratory protection prevent the body from cooling. Personnel must inform the field supervisor or HSO when experiencing any signs or symptoms of heat stress or observing a fellow employee (i.e., buddy) experiencing them. Heat stress stay times will be documented on the appropriate work control document(s), that is, an SWP, applicable company forms, or other by the HSO in conjunction with the IH (as required) when personnel wear PPE that may increase heat body burden. These stay times will take into account the amount of time spent on a task, the nature of the work (i.e., light, moderate, or heavy), type of PPE worn, and ambient work temperatures. Table 2-5 lists heat stress signs and symptoms of exposure.

Individuals showing any of the symptoms of heat exhaustion listed in Table 2-5 shall

- Stop work
- Exit or be helped from the work area
- Remove/decontaminate protective clothing (as applicable)
- Move to sheltered area to rest
- Be provided cool drinking water
- Be monitored by a medic or CPR/first aid-certified employee.

Table 2-5. Heat stress signs and symptoms of exposure.

Heat-Related Illness	Signs and Symptoms	Emergency Care
Heat rash	Red skin rash and reduced sweating.	Keep the skin clean, change all clothing daily, and cover affected areas with powder containing cornstarch or with plain cornstarch.
Heat cramps	Severe muscle cramps and exhaustion, sometimes with dizziness or periods of faintness.	Move the patient to a nearby cool place; give the patient half-strength electrolytic fluids; if cramps persist, or if signs that are more serious develop, seek medical attention.
Heat exhaustion	Rapid, shallow breathing; weak pulse; cold, clammy skin; heavy perspiration; total body weakness; dizziness that sometimes leads to unconsciousness.	Move the patient to a nearby cool place, keep the patient at rest, give the patient half-strength electrolytic fluids, treat for shock, and seek medical attention. DO NOT TRY TO ADMINISTER FLUIDS TO AN UNCONSCIOUS PATIENT.
Heat stroke	Deep, then shallow, breathing; rapid, strong pulse, then rapid, weak pulse; dry, hot skin; dilated pupils; loss of consciousness (possible coma); seizures or muscular twitching.	Cool the patient rapidly. Treat for shock. If cold packs or ice bags are available, wrap them and place one bag or pack under each armpit, behind each knee, one in the groin, one on each wrist and ankle, and one on each side of the neck. Seek medical attention as rapidly as possible. Monitor the patient's vital signs constantly. DO NOT ADMINISTER FLUIDS OF ANY KIND.

NOTE: Heat exhaustion and heat stroke are extremely serious conditions that can result in death and should be treated as such. The field supervisor or HSO should immediately request an ambulance (777 or 526-1515) be dispatched from the CFA-1612 medical facility and the individual cooled as described above in Table 2-5 based on the nature of the heat stress illness.

Monitoring for heat stress conditions shall be performed in accordance with applicable company policies and procedures. Depending on the ambient weather conditions, work conditions, type of PPE worn, and the Table physical response of work operations personnel, the IH shall inform the field supervisor/RCT of necessary adjustments to the work/rest cycle. Additionally, physiological monitoring may be conducted to determine if personnel are replenishing liquids fast enough. A supply of cool drinking water will be provided in designated eating areas and consumed only in these areas. ICDF personnel may periodically be interviewed by the IH/RCT or HSO to ensure that the controls are effective and that excessive heat exposure is not occurring. Workers will be encouraged to monitor their body signs and to take breaks if symptoms of heat stress occur.

2.4.2.2 Low Temperatures and Cold Stress. For outdoor ICDF operations, personnel will be exposed to low temperatures during fall and winter months or at other time of the year if relatively cool ambient temperatures combined with wet or windy exist. The IH and HSO will be responsible for obtaining meteorological information to determine if additional cold stress administrative controls are required. Applicable company policies and procedures discuss the hazards and monitoring of cold stress.

Table 2-6 provides the cold stress work and warm-up schedule if cold stress conditions exist (late fall, winter, early spring).

Additional cold weather hazards may exist from working on snow- or ice-covered surfaces. Slip, fall, and material-handling hazards are increased under these conditions. Every effort must be made to ensure walking surfaces are kept clear of ice. The field supervisor or HSO should be notified immediately if slip or fall hazards are identified at any ICDF location.

2.4.2.3 Ultraviolet Light Exposure. Personnel will be exposed to ultraviolet light (UV) (i.e., sunlight) when conducting ICDF operations outdoors. Sunlight is the main source of UV known to damage the skin and to cause skin cancer. The amount of UV exposure depends on the strength of the light, the length of exposure, and whether the skin is protected. No UV rays or suntans are safe. The following mitigative actions may be taken to minimize UV exposure:

- Wear clothing to cover the skin (long pants [no shorts] and long-sleeve or short-sleeve shirt [no tank tops])
- Use a sunscreen with a sun protection factor of at least 15
- Wear a hat (hard hat where required)
- Wear UV-absorbing safety glasses
- Limit exposure during peak intensity hours of 10 a.m. to 4 p.m. whenever possible.

2.4.3 Confined Spaces

Work in confined spaces may subject personnel to risks involving engulfment, entrapment, oxygen deficiency, and toxic or explosive atmospheres. If potential confined spaces are identified at the ICDF operational facilities they will be evaluated to determine if they are permit-required in accordance with applicable company policies and procedures. If entry into identified ICDF confined spaces are required, then all applicable company policies and procedures will be followed.

2.4.4 Working on and Near Water

An additional hazard includes the potential for persons drowning in the ponds if a person were to fall into one of the evaporation ponds and become unconscious, are rendered unable to function, or cannot swim. Each person working on (out of a boat or float) or near the slope of a pond containing liquid in sufficient quantities that drowning is possible must wear a personal flotation device (U.S. Coast Guard-approved life jacket or buoyant work vest) suitable for the intended purpose. Prior to and after each use, the buoyant device shall be inspected to ensure they are in proper working conditions according to the manufacturer specifications. Ring buoys with at least 90 ft of line shall be provided and readily available for emergency rescue operations. The distance between ring buoys shall not exceed 200 ft. At least one life-saving skiff shall be immediately available at locations where employees are working over or adjacent to water.

Hazard mitigation may also include the installation of protective devices which will prevent personnel from accidentally entering the pond water. These specific hazards and hazard mitigation will be outlined in the task-specific JSAs and TPRs as part of the work control procedures. ICDF tasks related to working on or near water will utilize the "buddy system" (as defined in Section 4.5).

Table 2-6. Cold stress work and warmup schedule.

Air Temperature °F (approximate)	No Noticeable Wind		Wind 5 mph		Wind 10 mph		Wind 15 mph		Wind 20 mph	
	Maximum Work Period	Number of Breaks	Maximum Work Period	Number of Breaks	Maximum Work Period	Number of Breaks	Maximum Work Period	Number of Breaks	Maximum Work Period	Number of Breaks
-15 to -19°	Normal breaks	1	Normal breaks	1	75 minutes	2	55 minutes	3	40 minutes	4
-20 to -24°	Normal breaks	1	75 minutes	2	55 minutes	3	40 minutes	4	30 minutes	5
-25 to -29°	75 minutes	2	55 minutes	3	40 minutes	4	30 minutes	5	Nonemergency work should cease	
-30 to -34°	55 minutes	3	40 minutes	4	30 minutes	5	Nonemergency work should cease			
-35 to -39°	40 minutes	4	30 minutes	5	Nonemergency work should cease					
-40 to -44°	30 minutes	5	Nonemergency work should cease							
-45° and below	Nonemergency work should cease									

2.4.5 Biological Hazards

The ICDF Complex is located in an area that provides habitat for various rodents, insects, and vectors (i.e., organisms that carry disease-causing microorganisms from one host to another). The potential exists for encountering nesting materials or other biological hazards and vectors. The hantavirus may be present in the nesting and fecal matter of deer mice. If such materials are disturbed, they can become airborne and create a potential inhalation pathway for the virus. Contact and improper removal of these materials may provide additional inhalation exposure risks.

If suspected rodent nesting or excrement material is encountered, the IH will be notified immediately and **no attempt will be made to remove or clean the area**. Following an evaluation of the area, disinfection and removal of such material will be conducted in accordance with applicable company policies and procedures.

Snakes, insects, and arachnids (e.g., spiders, ticks, and mosquitoes) also may be encountered at the ICDF. Common areas to avoid include material stacking and staging areas, under existing structures (e.g., trailers and buildings), under boxes, and other areas that provide shelter. Protective clothing will generally prevent insects from direct contact with the skin. If potentially dangerous snakes or spiders are found or are suspected of being present, warn others, keep clear and contact the IH or HSO for additional guidance as required.

Insect repellant (DEET or equivalent) may be required. Areas where standing water has accumulated (e.g., evaporation ponds) provide breeding grounds for mosquitoes and should be avoided. In cases where a large area of standing water is encountered, it may be necessary to pump the water out of the declivity (areas other than the evaporation ponds).

2.4.6 Inclement Weather Conditions

When inclement or adverse weather conditions develop that may pose a threat to persons or property at the ICDF area (such as sustained strong winds 25 mph or greater, electrical storms, heavy precipitation, or extreme heat or cold) these conditions will be evaluated and a decision made by the HSO, with input from the IH, safety engineer, RCT, and other personnel, as appropriate, to stop work, employ compensatory measures, or proceed. The field supervisor and HSO shall comply with company MCPs and facility work control documents that specify limits for inclement weather.

During all ICDF activities, the HSO, in consultation with the field supervisor, Radiological Control (RadCon) and IH personnel, will determine if wind or other weather conditions pose unacceptable hazards to personnel or the environment.

2.5 Other ICDF Hazards

ICDF personnel should continually look for potential hazards and immediately inform the field supervisor or HSO of the hazards so that action can be taken to correct the condition. All personnel have the authority to initiate STOP WORK actions in accordance with applicable company policies and procedures if it is perceived that an imminent safety of health hazard exists or take corrective actions within the scope of the work control authorization documents to correct minor safety of health hazards and then inform the field team leader (FTL).

Personnel working at the ICDF are responsible to use safe-work practices, report unsafe working conditions or acts, and exercise good housekeeping habits with respect to tools, equipment, and waste during ICDF operations.

2.6 Site Inspections

The HSO, RCT, and field supervisor may participate in ICDF site inspections during the work control preparation stage (such as the hazard identification and verification walkdowns), conduct self-assessments, or other inspections. Additionally, the HSO, project manager, or field supervisor, in accordance with applicable company policies and procedures, will perform periodic safety inspections.

Targeted or required self-assessments may be performed during ICDF operations in accordance with applicable company policies and procedures. All inspections and assessments will be documented and available for review by the field supervisor. The HSO or other health and safety professionals present at the ICDF may, at any time, recommend changes in work habits to the field supervisor. However, all changes that may affect the facility written work control documents (e.g., HASP, JSAs, RWPs, SWPs, work order) must have concurrence from the appropriate facility technical discipline representative onsite and a Document Action Request prepared to the applicable document as required.